Department of Defense
Fiscal Year (FY) 2015 Budget Estimates

March 2014

Air Force

Justification Book Volume 1

Research, Development, Test & Evaluation, Air Force

Vol–I

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Table of Volumes

Budget Activities 1, 2, and 3.....Volume 1

Budget Activities 4, 5, and 6.....Volume 2

Budget Activity 7.....Volume 3a

Budget Activity 7.....Volume 3b

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Volume 1 Table of Contents

Introduction and Explanation of Contents.....Volume 1 - v

Comptroller Exhibit R-1..... Volume 1 - vii

Master Program Element Table of Contents (by Budget Activity then Line Item Number)..... Volume 1 - xxiii

Master Program Element Table of Contents (Alphabetically by Program Element Title)..... Volume 1 - xxxix

Classified PEs.....Volume 1 - liii

FY15 PB Crosswalk Report.....Volume 1 - lv

Exhibit R-2's.....Volume 1 - 1

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Fiscal Year (FY) 2015 Budget Estimates
RDT&E Descriptive Summaries
Scientific and Technology Budget Activities
March 2014

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 2015 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 2015 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 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

04 Mar 2014

Appropriation	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base
Research, Development, Test & Eval, AF	23,163,315	23,571,637	9,000	23,580,637	23,739,892
Total Research, Development, Test & Evaluation	23,163,315	23,571,637	9,000	23,580,637	23,739,892

R-1C1: FY 2015 President's Budget (Published Version), as of March 4, 2014 at 13:04:42

Department of Defense
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
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04 Mar 2014

Summary Recap of Budget Activities	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base
Basic Research	460,881	524,770		524,770	454,490
Applied Research	1,008,540	1,146,421		1,146,421	1,081,133
Advanced Technology Development	568,508	636,442		636,442	593,817
Advanced Component Development & Prototypes	1,094,416	843,398		843,398	1,372,168
System Development & Demonstration	4,355,237	4,516,611		4,516,611	3,337,419
Management Support	1,418,857	1,114,458		1,114,458	1,183,199
Operational Systems Development	14,256,876	14,789,537		14,798,537	15,717,666
Total Research, Development, Test & Evaluation	23,163,315	23,571,637		23,580,637	23,739,892
Summary Recap of FYDP Programs					
Strategic Forces	148,190	186,769		186,769	570,597
General Purpose Forces	1,489,986	1,491,120		1,491,120	1,668,236
Intelligence and Communications	1,746,267	1,416,044		1,416,044	1,663,672
Mobility Forces	189,167	311,427		311,427	243,061
Research and Development	9,094,958	8,926,906		8,926,906	7,879,209
Central Supply and Maintenance	70,378	94,148		94,148	145,945
Training Medical and Other	319	1,727		1,727	2,538
Administration and Associated Activities	89,285	118,251		118,251	121,724
Support of Other Nations	3,376	3,785		3,785	3,790
Classified Programs	10,331,389	11,021,460	9,000	11,030,460	11,441,120
Total Research, Development, Test & Evaluation	23,163,315	23,571,637	9,000	23,580,637	23,739,892

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Department of the Air Force
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04 Mar 2014

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

Line No	Program Element Number	Item	Act	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base	Sec
1	0601102F	Defense Research Sciences	01	323,869	373,151		373,151	314,482	U
2	0601103F	University Research Initiatives	01	125,398	138,333		138,333	127,079	U
3	0601108F	High Energy Laser Research Initiatives	01	11,614	13,286		13,286	12,929	U
		Basic Research		460,881	524,770		524,770	454,490	
4	0602102F	Materials	02	111,177	120,846		120,846	105,680	U
5	0602201F	Aerospace Vehicle Technologies	02	108,536	119,624		119,624	105,747	U
6	0602202F	Human Effectiveness Applied Research	02	80,616	104,427		104,427	81,957	U
7	0602203F	Aerospace Propulsion	02	209,315	197,546		197,546	172,550	U
8	0602204F	Aerospace Sensors	02	115,568	127,419		127,419	118,343	U
9	0602601F	Space Technology	02	88,363	103,955		103,955	98,229	U
10	0602602F	Conventional Munitions	02	70,039	81,521		81,521	87,387	U
11	0602605F	Directed Energy Technology	02	96,401	112,783		112,783	125,955	U
12	0602788F	Dominant Information Sciences and Methods	02	94,292	138,145		138,145	147,789	U
13	0602890F	High Energy Laser Research	02	34,233	40,155		40,155	37,496	U
		Applied Research		1,008,540	1,146,421		1,146,421	1,081,133	
14	0603112F	Advanced Materials for Weapon Systems	03	54,334	54,572		54,572	32,177	U
15	0603199F	Sustainment Science and Technology (S&T)	03	5,833	12,800		12,800	15,800	U
16	0603203F	Advanced Aerospace Sensors	03	32,818	30,546		30,546	34,420	U
17	0603211F	Aerospace Technology Dev/Demo	03	72,462	77,329		77,329	91,062	U
18	0603216F	Aerospace Propulsion and Power Technology	03	146,776	159,291		159,291	124,236	U
19	0603270F	Electronic Combat Technology	03	24,181	43,381		43,381	47,602	U

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20	0603401F	Advanced Spacecraft Technology	03	57,612	67,894		67,894	69,026	U
21	0603444F	Maui Space Surveillance System (MSSS)	03	26,235	26,299		26,299	14,031	U
22	0603456F	Human Effectiveness Advanced Technology Development	03	19,303	20,902		20,902	21,788	U
23	0603601F	Conventional Weapons Technology	03	32,518	33,996		33,996	42,046	U
24	0603605F	Advanced Weapons Technology	03	16,994	19,000		19,000	23,542	U
25	0603680F	Manufacturing Technology Program	03	51,448	41,353		41,353	42,772	U
26	0603788F	Battlespace Knowledge Development and Demonstration	03	27,994	49,079		49,079	35,315	U
		Advanced Technology Development		568,508	636,442		636,442	593,817	
27	0603260F	Intelligence Advanced Development	04	3,525	3,983		3,983	5,408	U
28	0603287F	Physical Security Equipment	04	3,350	3,874		3,874		U
29	0603430F	Advanced EHF MILSATCOM (SPACE)	04	211,632					U
30	0603432F	Polar MILSATCOM (SPACE)	04	77,202					U
31	0603438F	Space Control Technology	04	20,584	22,862		22,862	6,075	U
32	0603742F	Combat Identification Technology	04	25,987	13,386		13,386	10,980	U
33	0603790F	NATO Research and Development	04	3,981	4,568		4,568	2,392	U
34	0603791F	International Space Cooperative R&D	04	569	379		379	833	U
35	0603830F	Space Security and Defense Program	04	9,557	24,764		24,764	32,313	U
36	0603850F	Integrated Broadcast Service - Dem/Val	04	18,216					U
37	0603851F	Intercontinental Ballistic Missile - Dem/Val	04	63,153	72,696		72,696	30,885	U
38	0603854F	Wideband Global SATCOM RDT&E (Space)	04	10,438					U
39	0603859F	Pollution Prevention - Dem/Val	04	956	953		953	1,798	U

R-1C1: FY 2015 President's Budget (Published Version), as of March 4, 2014 at 13:04:42

Department of the Air Force
FY 2015 President's Budget
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(Dollars in Thousands)

04 Mar 2014

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40	0604015F	Long Range Strike	04	258,707	359,437		359,437	913,728	U
41	0604283F	Battle Mgmt Com & Ctrl Sensor Development	04	100,507					U
42	0604317F	Technology Transfer	04	2,295	2,606		2,606	2,669	U
43	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	16,626	103		103		U
44	0604337F	Requirements Analysis and Maturation	04	14,760	11,884		11,884		U
45	0604422F	Weather System Follow-on	04					39,901	U
46	0604458F	Air & Space Ops Center	04		58,861		58,861		U
47	0604618F	Joint Direct Attack Munition	04		2,500		2,500		U
48	0604635F	Ground Attack Weapons Fuze Development	04	8,657	17,764		17,764		U
49	0604800F	F-35 - EMD	04					4,976	U
50	0604857F	Operationally Responsive Space	04	96,209	10,000		10,000		U
51	0604858F	Tech Transition Program	04	82,278	48,636		48,636	59,004	U
52	0105921F	Service Support to STRATCOM - Space Activities	04		2,779		2,779		U
53	0201184F	Counter Narco-Terrorism Program Office	04	1,540					U
54	0207110F	Next Generation Air Dominance	04					15,722	U
55	0207455F	Three Dimensional Long-Range Radar (3DELRR)	04		54,191		54,191	88,825	U
56	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	04	63,687	127,172		127,172	156,659	U
		Advanced Component Development & Prototypes		1,094,416	843,398		843,398	1,372,168	
57	0603260F	Intelligence Advanced Development	05		977		977		U
58	0603840F	Global Broadcast Service (GBS)	05	14,632					U
59	0604233F	Specialized Undergraduate Flight Training	05	5,151	3,601		3,601	13,324	U

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60	0604270F	Electronic Warfare Development	05	1,914	1,971		1,971	1,965	U
61	0604281F	Tactical Data Networks Enterprise	05	21,355	42,745		42,745	39,110	U
62	0604287F	Physical Security Equipment	05	51				3,926	U
63	0604329F	Small Diameter Bomb (SDB) - EMD	05	125,101	113,334		113,334	68,759	U
64	0604421F	Counterspace Systems	05	25,775	22,655		22,655	23,746	U
65	0604425F	Space Situation Awareness Systems	05	225,838	314,625		314,625	9,462	U
66	0604426F	Space Fence	05					214,131	U
67	0604429F	Airborne Electronic Attack	05	3,987	4,575		4,575	30,687	U
68	0604441F	Space Based Infrared System (SBIRS) High EMD	05	486,647	322,399		322,399	319,501	U
69	0604602F	Armament/Ordnance Development	05	8,874	13,661		13,661	31,112	U
70	0604604F	Submunitions	05	2,352	2,564		2,564	2,543	U
71	0604617F	Agile Combat Support	05	21,145	17,036		17,036	46,340	U
72	0604706F	Life Support Systems	05	5,832	7,273		7,273	8,854	U
73	0604735F	Combat Training Ranges	05	9,209	25,300		25,300	10,129	U
74	0604750F	Intelligence Equipment	05	736					U
75	0604800F	F-35 - EMD	05	1,129,879	628,454		628,454	563,037	U
76	0604851F	Intercontinental Ballistic Missile - EMD	05	120,375	112,760		112,760		U
77	0604853F	Evolved Expendable Launch Vehicle Program (SPACE) - EMD	05	29,949	24,938		24,938		U
78	0604932F	Long Range Standoff Weapon	05	1,836	5,000		5,000	4,938	U
79	0604933F	ICBM Fuze Modernization	05	65,370	118,411		118,411	59,826	U
80	0605030F	Joint Tactical Network Center (JTNC)	05					78	U

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Total Obligational Authority
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81	0605213F	F-22 Modernization Increment 3.2B	05	110,432	115,000		115,000	173,647	U
82	0605214F	Ground Attack Weapons Fuze Development	05					5,332	U
83	0605221F	KC-46	05	1,550,289	1,558,590		1,558,590	776,937	U
84	0605223F	Advanced Pilot Training	05					8,201	U
85	0605229F	CSAR HH-60 Recapitalization	05	32,787	333,558		333,558		U
86	0605278F	HC/MC-130 Recap RDT&E	05	10,548	2,611		2,611	7,497	U
87	0605431F	Advanced EHF MILSATCOM (SPACE)	05		265,634		265,634	314,378	U
88	0605432F	Polar MILSATCOM (SPACE)	05		104,582		104,582	103,552	U
89	0605433F	Wideband Global SATCOM (SPACE)	05		12,489		12,489	31,425	U
90	0605458F	Air & Space Ops Center 10.2 RDT&E	05					85,938	U
91	0605931F	B-2 Defensive Management System	05	249,685	257,500		257,500	98,768	U
92	0101125F	Nuclear Weapons Modernization	05	62,373	33,000		33,000	198,357	U
93	0207604F	Readiness Training Ranges, Operations and Maintenance	05	285					U
94	0207701F	Full Combat Mission Training	05	13,089	4,663		4,663	8,831	U
95	0307581F	NextGen JSTARS	05					73,088	U
96	0401318F	CV-22	05	19,741	46,705		46,705		U
		System Development & Demonstration		4,355,237	4,516,611		4,516,611	3,337,419	
97	0604256F	Threat Simulator Development	06	22,348	14,841		14,841	24,418	U
98	0604759F	Major T&E Investment	06	33,968	32,341		32,341	47,232	U
99	0605101F	RAND Project Air Force	06	28,132	32,956		32,956	30,443	U
100	0605502F	Small Business Innovation Research	06	318,816					U

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101	0605712F	Initial Operational Test & Evaluation	06	14,609	10,572		10,572	12,266	U
102	0605807F	Test and Evaluation Support	06	670,586	722,658		722,658	689,509	U
103	0605860F	Rocket Systems Launch Program (SPACE)	06	15,406	12,755		12,755	34,364	U
104	0605864F	Space Test Program (STP)	06	39,012	11,642		11,642	21,161	U
105	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	38,854	44,160		44,160	46,955	U
106	0605978F	Facilities Sustainment - Test and Evaluation Support	06	24,986	27,643		27,643	32,965	U
107	0606017F	Requirements Analysis and Maturation	06					13,850	U
108	0606116F	Space Test and Training Range Development	06					19,512	U
109	0606323F	Multi-Service Systems Engineering Initiative	06	12,367	6,908		6,908		U
110	0606392F	Space and Missile Center (SMC) Civilian Workforce	06	168,940	172,661		172,661	181,727	U
111	0308602F	ENTEPRISE INFORMATION SERVICES (EIS)	06					4,938	U
112	0702806F	Acquisition and Management Support	06	27,457	21,221		21,221	18,644	U
113	0804731F	General Skill Training	06		315		315	1,425	U
114	1001004F	International Activities	06	3,376	3,785		3,785	3,790	U
		Management Support		1,418,857	1,114,458		1,114,458	1,183,199	
115	0603423F	Global Positioning System III - Operational Control Segment	07	309,566	373,062		373,062	299,760	U
116	0604445F	Wide Area Surveillance	07		5,000		5,000		U
118	0604618F	Joint Direct Attack Munition	07					2,469	U
119	0605018F	AF Integrated Personnel and Pay System (AF-IPPS)	07	40,088	34,034		34,034	90,218	U
120	0605024F	Anti-Tamper Technology Executive Agency	07	30,413	26,541		26,541	34,815	U
122	0101113F	B-52 Squadrons	07	17,951	17,007		17,007	55,457	U

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123	0101122F	Air-Launched Cruise Missile (ALCM)	07	322	450		450	450	U
124	0101126F	B-1B Squadrons	07	13,126	12,774		12,774	5,353	U
125	0101127F	B-2 Squadrons	07	29,805	87,810		87,810	131,580	U
126	0101213F	Minuteman Squadrons	07					139,109	U
127	0101313F	Strat War Planning System - USSTRATCOM	07	20,452	31,325		31,325	35,603	U
128	0101314F	Night Fist - USSTRATCOM	07					32	U
130	0102326F	Region/Sector Operation Control Center Modernization Program	07	4,161	1,624		1,624	1,522	U
131	0105921F	Service Support to STRATCOM - Space Activities	07					3,134	U
132	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	4,416					U
133	0205219F	MQ-9 UAV	07	130,882	107,338		107,338	170,396	U
134	0207040F	Multi-Platform Electronic Warfare Equipment	07	39,250					U
135	0207131F	A-10 Squadrons	07	12,347	9,614		9,614		U
136	0207133F	F-16 Squadrons	07	155,152	112,667		112,667	133,105	U
137	0207134F	F-15E Squadrons	07	145,035	234,289		234,289	261,969	U
138	0207136F	Manned Destructive Suppression	07	13,362	11,022		11,022	14,831	U
139	0207138F	F-22A Squadrons	07	326,012	274,407		274,407	156,962	U
140	0207142F	F-35 Squadrons	07		3,000		3,000	43,666	U
141	0207161F	Tactical AIM Missiles	07	5,972	12,760		12,760	29,739	U
142	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	68,656	70,614		70,614	82,195	U
143	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07	1,428					U
144	0207171F	F-15 EPAWSS	07					68,944	U

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04 Mar 2014

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

Line No	Program Element Number	Item	Act	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base	Sec
145	0207224F	Combat Rescue and Recovery	07	1,910	2,582		2,582	5,095	U
146	0207227F	Combat Rescue - Pararescue	07	992	350		350	883	U
147	0207247F	AF TENCAP	07	58,514	89,816		89,816	5,812	U
148	0207249F	Precision Attack Systems Procurement	07	1,029	2,000		2,000	1,081	U
149	0207253F	Compass Call	07	10,733	10,745		10,745	14,411	U
150	0207268F	Aircraft Engine Component Improvement Program	07	114,802	89,369		89,369	109,664	U
151	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	7,095	6,373		6,373	15,897	U
152	0207410F	Air & Space Operations Center (AOC)	07	70,925	22,332		22,332	41,066	U
153	0207412F	Control and Reporting Center (CRC)	07	8,960	6,993		6,993	552	U
154	0207417F	Airborne Warning and Control System (AWACS)	07	47,171	148,369		148,369	180,804	U
155	0207418F	Tactical Airborne Control Systems	07	5,582	743		743	3,754	U
157	0207431F	Combat Air Intelligence System Activities	07	5,275	4,471		4,471	7,891	U
158	0207444F	Tactical Air Control Party-Mod	07	14,444	10,223		10,223	5,891	U
159	0207448F	C2ISR Tactical Data Link	07	1,447	1,406		1,406	1,782	U
160	0207449F	Command and Control (C2) Constellation	07	13,938	7,160		7,160		U
161	0207452F	DCAPES	07	13,925	10,111		10,111	821	U
162	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	23,566	23,148		23,148		U
163	0207590F	Seek Eagle	07	20,451	22,386		22,386	23,844	U
164	0207601F	USAF Modeling and Simulation	07	14,147	8,734		8,734	16,723	U
165	0207605F	Wargaming and Simulation Centers	07	5,071	5,512		5,512	5,956	U
166	0207697F	Distributed Training and Exercises	07	2,833	3,301		3,301	4,457	U

R-1C1: FY 2015 President's Budget (Published Version), as of March 4, 2014 at 13:04:42

Department of the Air Force
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

04 Mar 2014

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

Line No	Program Element Number	Item	Act	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base	Sec
167	0208006F	Mission Planning Systems	07	64,035	62,432		62,432	60,679	U
168	0208021F	Information Warfare Support	07	6,373					U
169	0208059F	Cyber Command Activities	07	59,342	38,099		38,099	67,057	U
170	0208087F	AF Offensive Cyberspace Operations	07		14,047		14,047	13,355	U
171	0208088F	AF Defensive Cyberspace Operations	07		5,853		5,853	5,576	U
179	0301400F	Space Superiority Intelligence	07	17,434	10,697		10,697	12,218	U
180	0302015F	E-4B National Airborne Operations Center (NAOC)	07	2,222	13,250		13,250	28,778	U
181	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	19,509	18,481		18,481	81,035	U
182	0303140F	Information Systems Security Program	07	60,837	74,530		74,530	70,497	U
183	0303141F	Global Combat Support System	07	3,094	725		725	692	U
184	0303150F	Global Command and Control System	07	2,082					U
185	0303601F	MILSATCOM Terminals	07	106,338	129,829		129,829	55,208	U
187	0304260F	Airborne SIGINT Enterprise	07	105,737	100,172		100,172	106,786	U
190	0305099F	Global Air Traffic Management (GATM)	07	4,390	4,027		4,027	4,157	U
191	0305103F	Cyber Security Initiative	07	1,900	2,048		2,048		U
192	0305105F	DoD Cyber Crime Center	07	254	288		288		U
193	0305110F	Satellite Control Network (SPACE)	07	30,944	35,657		35,657	20,806	U
194	0305111F	Weather Service	07	25,868	20,643		20,643	25,102	U
195	0305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	07	36,427	32,894		32,894	23,516	U
196	0305116F	Aerial Targets	07	41,040	17,773		17,773	8,639	U
199	0305128F	Security and Investigative Activities	07	343	195		195	498	U

R-1C1: FY 2015 President's Budget (Published Version), as of March 4, 2014 at 13:04:42

Department of the Air Force
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

04 Mar 2014

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

Line No	Program Element Number	Item	Act	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base	Sec
200	0305145F	Arms Control Implementation	07	3,666	1,430		1,430	13,222	U
201	0305146F	Defense Joint Counterintelligence Activities	07		10		10	360	U
203	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	26,011					U
204	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	12,436					U
206	0305173F	Space and Missile Test and Evaluation Center	07	3,188	3,696		3,696	3,674	U
207	0305174F	Space Innovation, Integration and Rapid Technology Development	07	2,149	2,469		2,469	2,480	U
208	0305179F	Integrated Broadcast Service (IBS)	07		6,954		6,954	8,592	U
209	0305182F	Spacelift Range System (SPACE)	07	7,808	12,312		12,312	13,462	U
210	0305202F	Dragon U-2	07	21,670	13,700		13,700	5,511	U
211	0305205F	Endurance Unmanned Aerial Vehicles	07	74,126	1,000		1,000		U
212	0305206F	Airborne Reconnaissance Systems	07	88,199	47,155		47,155	28,113	U
213	0305207F	Manned Reconnaissance Systems	07	12,205	13,491		13,491	13,516	U
214	0305208F	Distributed Common Ground/Surface Systems	07	43,580	6,321		6,321	27,265	U
215	0305219F	MQ-1 Predator A UAV	07	9,110	760		760	1,378	U
216	0305220F	RQ-4 UAV	07	240,234	120,180		120,180	244,514	U
217	0305221F	Network-Centric Collaborative Targeting	07	6,752	7,413		7,413	11,096	U
218	0305236F	Common Data Link (CDL)	07	33,630	33,899		33,899	36,137	U
219	0305238F	NATO AGS	07	192,571	221,589		221,589	232,851	U
220	0305240F	Support to DCGS Enterprise	07	22,454	19,309		19,309	20,218	U
221	0305265F	GPS III Space Segment	07	281,880	200,984		200,984	212,571	U
222	0305614F	JSPOC Mission System	07	52,974	56,523		56,523	73,779	U

R-1C1: FY 2015 President's Budget (Published Version), as of March 4, 2014 at 13:04:42

Department of the Air Force
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

04 Mar 2014

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

Line No	Program Element Number	Item	Act	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base	Sec
223	0305881F	Rapid Cyber Acquisition	07	1,790	2,218		2,218	4,102	U
224	0305887F	Intelligence Support to Information Warfare	07	11,847					U
225	0305913F	NUDET Detection System (SPACE)	07	58,074	42,506		42,506	20,468	U
226	0305940F	Space Situation Awareness Operations	07	16,730	12,684		12,684	11,596	U
227	0306250F	Cyber Operations Technology Development	07					4,938	U
228	0308699F	Shared Early Warning (SEW)	07	1,077	1,060		1,060	1,212	U
229	0401115F	C-130 Airlift Squadron	07	14,929	47,700		47,700		U
230	0401119F	C-5 Airlift Squadrons (IF)	07	12,220	48,617		48,617	38,773	U
231	0401130F	C-17 Aircraft (IF)	07	76,569	97,134		97,134	83,773	U
232	0401132F	C-130J Program	07	18,322	22,443		22,443	26,715	U
233	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	6,954	4,116		4,116	5,172	U
234	0401219F	KC-10s	07	18,450				2,714	U
235	0401314F	Operational Support Airlift	07	17,521	38,538		38,538	27,784	U
236	0401318F	CV-22	07					38,719	U
237	0401319F	Presidential Aircraft Replacement (PAR)	07					11,006	U
238	0408011F	Special Tactics / Combat Control	07	4,461	6,174		6,174	8,405	U
239	0702207F	Depot Maintenance (Non-IF)	07	1,455	1,605		1,605	1,407	U
240	0708012F	Logistics Support Activities	07	451					U
241	0708610F	Logistics Information Technology (LOGIT)	07	27,070	60,410		60,410	109,685	U
242	0708611F	Support Systems Development	07	13,945	10,912		10,912	16,209	U
243	0804743F	Other Flight Training	07	319	1,347		1,347	987	U

R-1C1: FY 2015 President's Budget (Published Version), as of March 4, 2014 at 13:04:42

Department of the Air Force
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

04 Mar 2014

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

Line No	Program Element Number	Item	Act	FY 2013 (Base & OCO)	FY 2014 Base Enacted	FY 2014 OCO Enacted	FY 2014 Total Enacted	FY 2015 Base	Sec
244	0808716F	Other Personnel Activities	07		65		65	126	U
245	0901202F	Joint Personnel Recovery Agency	07	1,790	1,083		1,083	2,603	U
246	0901218F	Civilian Compensation Program	07	2,564	1,577		1,577	1,589	U
247	0901220F	Personnel Administration	07	2,348	5,990		5,990	5,026	U
248	0901226F	Air Force Studies and Analysis Agency	07	599	786		786	1,394	U
249	0901279F	Facilities Operation - Administrative	07	2,805	654		654	3,798	U
250	0901538F	Financial Management Information Systems Development	07	79,179	108,161		108,161	107,314	U
9999	9999999999	Classified Programs		10,331,389	11,021,460	9,000	11,030,460	11,441,120	U
		Operational Systems Development		14,256,876	14,789,537		14,798,537	15,717,666	
Total Research, Development, Test & Eval, AF				23,163,315	23,571,637		23,580,637	23,739,892	

R-1C1: FY 2015 President's Budget (Published Version), as of March 4, 2014 at 13:04:42

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

Budget Activity 01: Basic Research
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
1	01	0601102F	Defense Research Sciences	Volume 1 - 1
2	01	0601103F	University Research Initiatives	Volume 1 - 15
3	01	0601108F	High Energy Laser Research Initiatives	Volume 1 - 19

Budget Activity 02: Applied Research
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
4	02	0602102F	Materials	Volume 1 - 23
5	02	0602201F	Aerospace Vehicle Technologies	Volume 1 - 39
6	02	0602202F	Human Effectiveness Applied Research	Volume 1 - 53
7	02	0602203F	Aerospace Propulsion	Volume 1 - 69
8	02	0602204F	Aerospace Sensors	Volume 1 - 93
9	02	0602601F	Space Technology	Volume 1 - 113

Budget Activity 02: Applied Research
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
10	02	0602602F	Conventional Munitions	Volume 1 - 131
11	02	0602605F	Directed Energy Technology	Volume 1 - 139
12	02	0602788F	Dominant Information Sciences and Methods	Volume 1 - 147
13	02	0602890F	High Energy Laser Research	Volume 1 - 167

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

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
14	03	0603112F	Advanced Materials for Weapon Systems	Volume 1 - 173
15	03	0603199F	Sustainment Science and Technology (S&T)	Volume 1 - 185
16	03	0603203F	Advanced Aerospace Sensors	Volume 1 - 191
17	03	0603211F	Aerospace Technology Dev/Demo	Volume 1 - 201
18	03	0603216F	Aerospace Propulsion and Power Technology	Volume 1 - 211
19	03	0603270F	Electronic Combat Technology	Volume 1 - 229
20	03	0603401F	Advanced Spacecraft Technology	Volume 1 - 241
21	03	0603444F	Maui Space Surveillance System (MSSS)	Volume 1 - 263

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

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
22	03	0603456F	Human Effectiveness Advanced Technology Development	Volume 1 - 267
23	03	0603601F	Conventional Weapons Technology	Volume 1 - 281
24	03	0603605F	Advanced Weapons Technology	Volume 1 - 285
25	03	0603680F	Manufacturing Technology Program	Volume 1 - 291
26	03	0603788F	Battlespace Knowledge Development and Demonstration	Volume 1 - 295

Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
27	04	0603260F	Intelligence Advanced Development	Volume 2 - 1
28	04	0603287F	Physical Security Equipment	Volume 2 - 33
29	04	0603430F	Advanced EHF MILSATCOM (SPACE)	Volume 2 - 39
30	04	0603432F	Polar MILSATCOM (SPACE)	Volume 2 - 59
31	04	0603438F	Space Control Technology	Volume 2 - 67
32	04	0603742F	Combat Identification Technology	Volume 2 - 77
33	04	0603790F	NATO Research and Development	Volume 2 - 93

Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
34	04	0603791F	International Space Cooperative R&D	Volume 2 - 97
35	04	0603830F	Space Security and Defense Program	Volume 2 - 101
36	04	0603850F	Integrated Broadcast Service - Dem/Val	Volume 2 - 109
37	04	0603851F	Intercontinental Ballistic Missile - Dem/Val	Volume 2 - 115
38	04	0603854F	Wideband Global SATCOM RDT&E (Space)	Volume 2 - 135
39	04	0603859F	Pollution Prevention - Dem/Val	Volume 2 - 139
40	04	0604015F	Long Range Strike	Volume 2 - 145
41	04	0604283F	Battle Mgmt Com & Ctrl Sensor Development	Volume 2 - 149
42	04	0604317F	Technology Transfer	Volume 2 - 163
43	04	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	Volume 2 - 167
44	04	0604337F	Requirements Analysis and Maturation	Volume 2 - 175
45	04	0604422F	Weather System Follow-on	Volume 2 - 185
46	04	0604458F	Air & Space Ops Center	Volume 2 - 195
47	04	0604618F	Joint Direct Attack Munition	Volume 2 - 203
48	04	0604635F	Ground Attack Weapons Fuze Development	Volume 2 - 209
49	04	0604800F	F-35 - EMD	Volume 2 - 215
50	04	0604857F	Operationally Responsive Space	Volume 2 - 217
51	04	0604858F	Tech Transition Program	Volume 2 - 223

Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
52	04	0105921F	Service Support to STRATCOM - Space Activities	Volume 2 - 229
53	04	0201184F	Counter Narcotics Technology Program Office	Volume 2 - 233
54	04	0207110F	Next Generation Air Dominance	Volume 2 - 235
55	04	0207455F	Three Dimensional Long-Range Radar (3DELRR)	Volume 2 - 239
56	04	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	Volume 2 - 247

Budget Activity 05: System Development & Demonstration (SDD)
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
57	05	0603260F	Intelligence Advanced Development	Volume 2 - 257
58	05	0603840F	Global Broadcast Service (GBS)	Volume 2 - 261
59	05	0604233F	Specialized Undergraduate Flight Training	Volume 2 - 265
60	05	0604270F	Electronic Warfare Development	Volume 2 - 287
61	05	0604281F	Tactical Data Networks Enterprise	Volume 2 - 291
62	05	0604287F	Physical Security Equipment	Volume 2 - 305
63	05	0604329F	Small Diameter Bomb (SDB) - EMD	Volume 2 - 311

Budget Activity 05: System Development & Demonstration (SDD)
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
64	05	0604421F	Counterspace Systems	Volume 2 - 321
65	05	0604425F	Space Situation Awareness Systems	Volume 2 - 333
66	05	0604426F	Space Fence	Volume 2 - 351
67	05	0604429F	Airborne Electronic Attack	Volume 2 - 359
68	05	0604441F	Space Based Infrared System (SBIRS) High EMD	Volume 2 - 365
69	05	0604602F	Armament/Ordnance Development	Volume 2 - 391
70	05	0604604F	Submunitions	Volume 2 - 407
71	05	0604617F	Agile Combat Support	Volume 2 - 415
72	05	0604706F	Life Support Systems	Volume 2 - 427
73	05	0604735F	Combat Training Ranges	Volume 2 - 433
74	05	0604750F	Intelligence Equipment	Volume 2 - 441
75	05	0604800F	F-35 - EMD	Volume 2 - 445
76	05	0604851F	Intercontinental Ballistic Missile - EMD	Volume 2 - 473
77	05	0604853F	Evolved Expendable Launch Vehicle Program (SPACE) - EMD	Volume 2 - 489
78	05	0604932F	Long Range Standoff Weapon	Volume 2 - 497
79	05	0604933F	ICBM Fuze Modernization	Volume 2 - 503
80	05	0605030F	Joint Tactical Network Center (JTNC)	Volume 2 - 513
81	05	0605213F	F-22 Modernization Increment 3.2B	Volume 2 - 517

Budget Activity 05: System Development & Demonstration (SDD)
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
82	05	0605214F	Ground Attack Weapons Fuze Development	Volume 2 - 527
83	05	0605221F	KC-46	Volume 2 - 531
84	05	0605223F	Advanced Pilot Training	Volume 2 - 541
85	05	0605229F	CSAR HH-60 Recapitalization	Volume 2 - 555
86	05	0605278F	HC/MC-130 Recap RDT&E	Volume 2 - 559
87	05	0605431F	Advanced EHF MILSATCOM (SPACE)	Volume 2 - 567
88	05	0605432F	Polar MILSATCOM (SPACE)	Volume 2 - 585
89	05	0605433F	WIDEBAND GLOBAL SATCOM (SPACE)	Volume 2 - 593
90	05	0605458F	Air & Space Ops Center 10.2 RDT&E	Volume 2 - 601
91	05	0605931F	B-2 Defensive Management System	Volume 2 - 609
92	05	0101125F	Nuclear Weapons Modernization	Volume 2 - 617
93	05	0207604F	Readiness Training Ranges, Operations and Maintenance	Volume 2 - 629
94	05	0207701F	Full Combat Mission Training	Volume 2 - 633
95	05	0307581F	NextGen JSTARS	Volume 2 - 643
96	05	0401318F	CV-22	Volume 2 - 649

Budget Activity 06: RDT&E Management Support
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
97	06	0604256F	Threat Simulator Development	Volume 2 - 659
98	06	0604759F	Major T&E Investment	Volume 2 - 669
99	06	0605101F	RAND Project Air Force	Volume 2 - 677
100	06	0605502F	Small Business Innovation Research	Volume 2 - 683
101	06	0605712F	Initial Operational Test & Evaluation	Volume 2 - 685
102	06	0605807F	Test and Evaluation Support	Volume 2 - 693
103	06	0605860F	Rocket Systems Launch Program (SPACE)	Volume 2 - 701
104	06	0605864F	Space Test Program (STP)	Volume 2 - 705
105	06	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	Volume 2 - 711
106	06	0605978F	Facilities Sustainment - Test and Evaluation Support	Volume 2 - 715
107	06	0606017F	Requirements Analysis and Maturation	Volume 2 - 721
108	06	0606116F	Space Test and Training Range Development	Volume 2 - 725
109	06	0606323F	Multi-Service Systems Engineering Initiative	Volume 2 - 729
110	06	0606392F	Space and Missile Center (SMC) Civilian Workforce	Volume 2 - 733
111	06	0308602F	ENTEPRISE INFORMATION SERVICES (EIS)	Volume 2 - 737
112	06	0702806F	Acquisition and Management Support	Volume 2 - 741

Budget Activity 06: RDT&E Management Support
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
113	06	0804731F	General Skill Training	Volume 2 - 757
114	06	1001004F	International Activities	Volume 2 - 759

Budget Activity 07: Operational Systems Development
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
115	07	0603423F	Global Positioning System III - Operational Control Segment	Volume 3a - 1
116	07	0604445F	Wide Area Surveillance	Volume 3a - 19
118	07	0604618F	Joint Direct Attack Munition	Volume 3a - 23
119	07	0605018F	AF Integrated Personnel and Pay System (AF-IPPS)	Volume 3a - 31
120	07	0605024F	Anti-Tamper Technology Executive Agency	Volume 3a - 41
122	07	0101113F	B-52 SQUADRONS	Volume 3a - 47
123	07	0101122F	Air-Launched Cruise Missile (ALCM)	Volume 3a - 69
124	07	0101126F	B-1B Squadrons	Volume 3a - 75
125	07	0101127F	B-2 SQUADRONS	Volume 3a - 81
126	07	0101213F	Minuteman Squadrons	Volume 3a - 101

Budget Activity 07: Operational Systems Development
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
127	07	0101313F	Strat War Planning System - USSTRATCOM	Volume 3a - 125
130	07	0102326F	Region/Sector Operation Control Center Modernization Program	Volume 3a - 139
131	07	0105921F	Service Support to STRATCOM - Space Activities	Volume 3a - 143
132	07	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	Volume 3a - 149
133	07	0205219F	MQ-9 UAV	Volume 3a - 153
134	07	0207040F	Multi-Platform Electronic Warfare Equipment	Volume 3a - 169
135	07	0207131F	A-10 Squadrons	Volume 3a - 173
136	07	0207133F	F-16 Squadrons	Volume 3a - 177
137	07	0207134F	F-15E Squadrons	Volume 3a - 189
138	07	0207136F	Manned Destructive Suppression	Volume 3a - 203
139	07	0207138F	F-22A Squadrons	Volume 3a - 209
140	07	0207142F	F-35 Squadrons	Volume 3a - 231
141	07	0207161F	Tactical AIM Missiles	Volume 3a - 251
142	07	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	Volume 3a - 259
143	07	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	Volume 3a - 269
144	07	0207171F	F-15 EPAWSS	Volume 3a - 273
145	07	0207224F	Combat Rescue and Recovery	Volume 3a - 281
146	07	0207227F	Combat Rescue - Pararescue	Volume 3a - 285

Budget Activity 07: Operational Systems Development
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
147	07	0207247F	AF TENCAP	Volume 3a - 291
148	07	0207249F	Precision Attack Systems Procurement	Volume 3a - 297
149	07	0207253F	Compass Call	Volume 3a - 301
150	07	0207268F	Aircraft Engine Component Improvement Program	Volume 3a - 305
151	07	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	Volume 3a - 315
152	07	0207410F	Air & Space Operations Center (AOC)	Volume 3a - 331
153	07	0207412F	Control and Reporting Center (CRC)	Volume 3a - 353
154	07	0207417F	Airborne Warning and Control System (AWACS)	Volume 3a - 357
155	07	0207418F	Tactical Airborne Control Systems	Volume 3a - 371
157	07	0207431F	Combat Air Intelligence System Activities	Volume 3a - 377
158	07	0207444F	Tactical Air Control Party-Mod	Volume 3a - 385
159	07	0207448F	C2ISR Tactical Data Link	Volume 3a - 391
160	07	0207449F	Command and Control (C2) Constellation	Volume 3a - 397
161	07	0207452F	DCAPES	Volume 3a - 409
162	07	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	Volume 3a - 419
163	07	0207590F	Seek Eagle	Volume 3a - 425
164	07	0207601F	USAF Modeling and Simulation	Volume 3a - 431
165	07	0207605F	Wargaming and Simulation Centers	Volume 3a - 441

Budget Activity 07: Operational Systems Development
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
166	07	0207697F	Distributed Training and Exercises	Volume 3a - 447
167	07	0208006F	Mission Planning Systems	Volume 3a - 453
168	07	0208021F	Information Warfare Support	Volume 3a - 483
169	07	0208059F	CYBER COMMAND ACTIVITIES	Volume 3a - 487
170	07	0208087F	AF Offensive Cyberspace Operations	Volume 3a - 493
171	07	0208088F	AF Defensive Cyberspace Operations	Volume 3a - 501
179	07	0301400F	Space Superiority Intelligence	Volume 3b - 1
180	07	0302015F	E-4B National Airborne Operations Center (NAOC)	Volume 3b - 5
181	07	0303131F	Minimum Essential Emergency Communications Network (MEECN)	Volume 3b - 11
182	07	0303140F	Information Systems Security Program	Volume 3b - 19
183	07	0303141F	Global Combat Support System	Volume 3b - 41
184	07	0303150F	Global Command and Control System	Volume 3b - 47
185	07	0303601F	MILSATCOM Terminals	Volume 3b - 51
187	07	0304260F	Airborne SIGINT Enterprise	Volume 3b - 67
190	07	0305099F	Global Air Traffic Management (GATM)	Volume 3b - 91
191	07	0305103F	Cyber Security Initiative	Volume 3b - 97
192	07	0305105F	DoD Cyber Crime Center	Volume 3b - 101
193	07	0305110F	Satellite Control Network (SPACE)	Volume 3b - 105

Budget Activity 07: Operational Systems Development
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
194	07	0305111F	Weather Service	Volume 3b - 111
195	07	0305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	Volume 3b - 119
196	07	0305116F	Aerial Targets	Volume 3b - 127
199	07	0305128F	Security and Investigative Activities	Volume 3b - 139
200	07	0305145F	Arms Control Implementation	Volume 3b - 145
201	07	0305146F	Defense Joint Counterintelligence Activities	Volume 3b - 153
203	07	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	Volume 3b - 155
204	07	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	Volume 3b - 163
206	07	0305173F	Space and Missile Test and Evaluation Center	Volume 3b - 171
207	07	0305174F	Space Innovation, Integration and Rapid Technology Development	Volume 3b - 175
208	07	0305179F	Integrated Broadcast Service (IBS)	Volume 3b - 181
209	07	0305182F	Spacelift Range System (SPACE)	Volume 3b - 187
210	07	0305202F	Dragon U-2	Volume 3b - 193
211	07	0305205F	Endurance Unmanned Aerial Vehicles	Volume 3b - 199
212	07	0305206F	Airborne Reconnaissance Systems	Volume 3b - 207
213	07	0305207F	Manned Reconnaissance Systems	Volume 3b - 231
214	07	0305208F	Distributed Common Ground/Surface Systems	Volume 3b - 237
215	07	0305219F	MQ-1 Predator A UAV	Volume 3b - 251

Budget Activity 07: Operational Systems Development
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
216	07	0305220F	RQ-4 UAV	Volume 3b - 257
217	07	0305221F	Network-Centric Collaborative Targeting	Volume 3b - 293
218	07	0305236F	Common Data Link (CDL)	Volume 3b - 299
219	07	0305238F	NATO AGS	Volume 3b - 305
220	07	0305240F	Support to DCGS Enterprise	Volume 3b - 311
221	07	0305265F	GPS III Space Segment	Volume 3b - 321
222	07	0305614F	JSPOC Mission System	Volume 3b - 335
223	07	0305881F	Rapid Cyber Acquisition	Volume 3b - 351
224	07	0305887F	Intelligence Support to Information Warfare	Volume 3b - 357
225	07	0305913F	NUDET Detection System (SPACE)	Volume 3b - 363
226	07	0305940F	Space Situation Awareness Operations	Volume 3b - 369
227	07	0306250F	Cyber Operations Technology Development	Volume 3b - 377
228	07	0308699F	Shared Early Warning (SEW)	Volume 3b - 381
229	07	0401115F	C-130 Airlift Squadron	Volume 3b - 387
230	07	0401119F	C-5 Airlift Squadrons (IF)	Volume 3b - 397
231	07	0401130F	C-17 Aircraft (IF)	Volume 3b - 403
232	07	0401132F	C-130J Program	Volume 3b - 409
233	07	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	Volume 3b - 425

Budget Activity 07: Operational Systems Development
Appropriation 3600: Research, Development, Test & Evaluation, Air Force

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
234	07	0401219F	KC-10s	Volume 3b - 431
235	07	0401314F	Operational Support Airlift	Volume 3b - 435
236	07	0401318F	CV-22	Volume 3b - 449
237	07	0401319F	Presidental Aircraft Replacement (PAR)	Volume 3b - 459
238	07	0408011F	Special Tactics / Combat Control	Volume 3b - 467
239	07	0702207F	Depot Maintenance (Non-IF)	Volume 3b - 473
240	07	0708012F	Logistics Support Activities	Volume 3b - 479
241	07	0708610F	Logistics Information Technology (LOGIT)	Volume 3b - 483
242	07	0708611F	Support Systems Development	Volume 3b - 513
243	07	0804743F	Other Flight Training	Volume 3b - 523
244	07	0808716F	Other Personnel Activities	Volume 3b - 531
245	07	0901202F	Joint Personnel Recovery Agency	Volume 3b - 535
246	07	0901218F	Civilian Compensation Program	Volume 3b - 539
247	07	0901220F	Personnel Administration	Volume 3b - 543
248	07	0901226F	Air Force Studies and Analysis Agency	Volume 3b - 549
249	07	0901279F	Facilities Operation - Administrative	Volume 3b - 553
250	07	0901538F	Financial Management Information Systems Development	Volume 3b - 557

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

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
A-10 Squadrons	0207131F	135	07	Volume 3a - 173
AF Defensive Cyberspace Operations	0208088F	171	07	Volume 3a - 501
AF Integrated Personnel and Pay System (AF-IPPS)	0605018F	119	07	Volume 3a - 31
AF Offensive Cyberspace Operations	0208087F	170	07	Volume 3a - 493
AF TENCAP	0207247F	147	07	Volume 3a - 291
Acquisition and Management Support	0702806F	112	06	Volume 2 - 741
Advanced Aerospace Sensors	0603203F	16	03	Volume 1 - 191
Advanced EHF MILSATCOM (SPACE)	0603430F	29	04	Volume 2 - 39
Advanced EHF MILSATCOM (SPACE)	0605431F	87	05	Volume 2 - 567
Advanced Materials for Weapon Systems	0603112F	14	03	Volume 1 - 173
Advanced Medium Range Air-to-Air Missile (AMRAAM)	0207163F	142	07	Volume 3a - 259
Advanced Pilot Training	0605223F	84	05	Volume 2 - 541
Advanced Spacecraft Technology	0603401F	20	03	Volume 1 - 241
Advanced Weapons Technology	0603605F	24	03	Volume 1 - 285
Aerial Targets	0305116F	196	07	Volume 3b - 127
Aerospace Propulsion	0602203F	7	02	Volume 1 - 69
Aerospace Propulsion and Power Technology	0603216F	18	03	Volume 1 - 211

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Aerospace Sensors	0602204F	8	02	Volume 1 - 93
Aerospace Technology Dev/Demo	0603211F	17	03	Volume 1 - 201
Aerospace Vehicle Technologies	0602201F	5	02	Volume 1 - 39
Agile Combat Support	0604617F	71	05	Volume 2 - 415
Air & Space Operations Center (AOC)	0207410F	152	07	Volume 3a - 331
Air & Space Ops Center	0604458F	46	04	Volume 2 - 195
Air & Space Ops Center 10.2 RDT&E	0605458F	90	05	Volume 2 - 601
Air Force Studies and Analysis Agency	0901226F	248	07	Volume 3b - 549
Air Traffic Control, Approach, and Landing System (ATCALS)	0305114F	195	07	Volume 3b - 119
Air-Launched Cruise Missile (ALCM)	0101122F	123	07	Volume 3a - 69
Airborne Electronic Attack	0604429F	67	05	Volume 2 - 359
Airborne Reconnaissance Systems	0305206F	212	07	Volume 3b - 207
Airborne SIGINT Enterprise	0304260F	187	07	Volume 3b - 67
Airborne Warning and Control System (AWACS)	0207417F	154	07	Volume 3a - 357
Aircraft Engine Component Improvement Program	0207268F	150	07	Volume 3a - 305
Anti-Tamper Technology Executive Agency	0605024F	120	07	Volume 3a - 41
Armament/Ordnance Development	0604602F	69	05	Volume 2 - 391
Arms Control Implementation	0305145F	200	07	Volume 3b - 145
B-1B Squadrons	0101126F	124	07	Volume 3a - 75

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
B-2 Defensive Management System	0605931F	91	05	Volume 2 - 609
B-2 SQUADRONS	0101127F	125	07	Volume 3a - 81
B-52 SQUADRONS	0101113F	122	07	Volume 3a - 47
Battle Mgmt Com & Ctrl Sensor Development	0604283F	41	04	Volume 2 - 149
Battlespace Knowledge Development and Demonstration	0603788F	26	03	Volume 1 - 295
C-130 Airlift Squadron	0401115F	229	07	Volume 3b - 387
C-130J Program	0401132F	232	07	Volume 3b - 409
C-17 Aircraft (IF)	0401130F	231	07	Volume 3b - 403
C-5 Airlift Squadrons (IF)	0401119F	230	07	Volume 3b - 397
C2ISR Tactical Data Link	0207448F	159	07	Volume 3a - 391
CSAR HH-60 Recapitalization	0605229F	85	05	Volume 2 - 555
CV-22	0401318F	96	05	Volume 2 - 649
CV-22	0401318F	236	07	Volume 3b - 449
CYBER COMMAND ACTIVITIES	0208059F	169	07	Volume 3a - 487
Civilian Compensation Program	0901218F	246	07	Volume 3b - 539
Combat Air Intelligence System Activities	0207431F	157	07	Volume 3a - 377
Combat Identification Technology	0603742F	32	04	Volume 2 - 77
Combat Rescue - Pararescue	0207227F	146	07	Volume 3a - 285
Combat Rescue and Recovery	0207224F	145	07	Volume 3a - 281

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Combat Training Ranges	0604735F	73	05	Volume 2 - 433
Command and Control (C2) Constellation	0207449F	160	07	Volume 3a - 397
Common Data Link (CDL)	0305236F	218	07	Volume 3b - 299
Compass Call	0207253F	149	07	Volume 3a - 301
Control and Reporting Center (CRC)	0207412F	153	07	Volume 3a - 353
Conventional Munitions	0602602F	10	02	Volume 1 - 131
Conventional Weapons Technology	0603601F	23	03	Volume 1 - 281
Counter Narcotics Technology Program Office	0201184F	53	04	Volume 2 - 233
Counterspace Systems	0604421F	64	05	Volume 2 - 321
Cyber Operations Technology Development	0306250F	227	07	Volume 3b - 377
Cyber Security Initiative	0305103F	191	07	Volume 3b - 97
DCAPES	0207452F	161	07	Volume 3a - 409
Defense Joint Counterintelligence Activities	0305146F	201	07	Volume 3b - 153
Defense Research Sciences	0601102F	1	01	Volume 1 - 1
Depot Maintenance (Non-IF)	0702207F	239	07	Volume 3b - 473
Directed Energy Technology	0602605F	11	02	Volume 1 - 139
Distributed Common Ground/Surface Systems	0305208F	214	07	Volume 3b - 237
Distributed Training and Exercises	0207697F	166	07	Volume 3a - 447
DoD Cyber Crime Center	0305105F	192	07	Volume 3b - 101

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Dominant Information Sciences and Methods	0602788F	12	02	Volume 1 - 147
Dragon U-2	0305202F	210	07	Volume 3b - 193
E-4B National Airborne Operations Center (NAOC)	0302015F	180	07	Volume 3b - 5
ENTEPRISE INFORMATION SERVICES (EIS)	0308602F	111	06	Volume 2 - 737
Electronic Combat Technology	0603270F	19	03	Volume 1 - 229
Electronic Warfare Development	0604270F	60	05	Volume 2 - 287
Endurance Unmanned Aerial Vehicles	0305205F	211	07	Volume 3b - 199
Evolved Expendable Launch Vehicle Program (SPACE) - EMD	0604853F	77	05	Volume 2 - 489
F-15 EPAWSS	0207171F	144	07	Volume 3a - 273
F-15E Squadrons	0207134F	137	07	Volume 3a - 189
F-16 Squadrons	0207133F	136	07	Volume 3a - 177
F-22 Modernization Increment 3.2B	0605213F	81	05	Volume 2 - 517
F-22A Squadrons	0207138F	139	07	Volume 3a - 209
F-35 - EMD	0604800F	49	04	Volume 2 - 215
F-35 - EMD	0604800F	75	05	Volume 2 - 445
F-35 Squadrons	0207142F	140	07	Volume 3a - 231
Facilities Operation - Administrative	0901279F	249	07	Volume 3b - 553
Facilities Restoration and Modernization - Test and Evaluation Support	0605976F	105	06	Volume 2 - 711
Facilities Sustainment - Test and Evaluation Support	0605978F	106	06	Volume 2 - 715

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Financial Management Information Systems Development	0901538F	250	07	Volume 3b - 557
Full Combat Mission Training	0207701F	94	05	Volume 2 - 633
GPS III Space Segment	0305265F	221	07	Volume 3b - 321
General Skill Training	0804731F	113	06	Volume 2 - 757
Global Air Traffic Management (GATM)	0305099F	190	07	Volume 3b - 91
Global Broadcast Service (GBS)	0603840F	58	05	Volume 2 - 261
Global Combat Support System	0303141F	183	07	Volume 3b - 41
Global Command and Control System	0303150F	184	07	Volume 3b - 47
Global Positioning System III - Operational Control Segment	0603423F	115	07	Volume 3a - 1
Ground Attack Weapons Fuze Development	0604635F	48	04	Volume 2 - 209
Ground Attack Weapons Fuze Development	0605214F	82	05	Volume 2 - 527
HC/MC-130 Recap RDT&E	0605278F	86	05	Volume 2 - 559
Hard and Deeply Buried Target Defeat System (HDBTDS) Program	0604327F	43	04	Volume 2 - 167
High Energy Laser Research	0602890F	13	02	Volume 1 - 167
High Energy Laser Research Initiatives	0601108F	3	01	Volume 1 - 19
Human Effectiveness Advanced Technology Development	0603456F	22	03	Volume 1 - 267
Human Effectiveness Applied Research	0602202F	6	02	Volume 1 - 53
ICBM Fuze Modernization	0604933F	79	05	Volume 2 - 503
Information Systems Security Program	0303140F	182	07	Volume 3b - 19

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Information Warfare Support	0208021F	168	07	Volume 3a - 483
Initial Operational Test & Evaluation	0605712F	101	06	Volume 2 - 685
Integrated Broadcast Service (IBS)	0305179F	208	07	Volume 3b - 181
Integrated Broadcast Service - Dem/Val	0603850F	36	04	Volume 2 - 109
Intelligence Advanced Development	0603260F	27	04	Volume 2 - 1
Intelligence Advanced Development	0603260F	57	05	Volume 2 - 257
Intelligence Equipment	0604750F	74	05	Volume 2 - 441
Intelligence Support to Information Warfare	0305887F	224	07	Volume 3b - 357
Intercontinental Ballistic Missile - Dem/Val	0603851F	37	04	Volume 2 - 115
Intercontinental Ballistic Missile - EMD	0604851F	76	05	Volume 2 - 473
International Activities	1001004F	114	06	Volume 2 - 759
International Space Cooperative R&D	0603791F	34	04	Volume 2 - 97
JSPOC Mission System	0305614F	222	07	Volume 3b - 335
Joint Air-to-Surface Standoff Missile (JASSM)	0207325F	151	07	Volume 3a - 315
Joint Direct Attack Munition	0604618F	47	04	Volume 2 - 203
Joint Direct Attack Munition	0604618F	118	07	Volume 3a - 23
Joint Helmet Mounted Cueing System (JHMCS)	0207170F	143	07	Volume 3a - 269
Joint Personnel Recovery Agency	0901202F	245	07	Volume 3b - 535
Joint Surveillance/Target Attack Radar System (JSTARS)	0207581F	162	07	Volume 3a - 419

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Joint Tactical Network Center (JTNC)	0605030F	80	05	Volume 2 - 513
KC-10s	0401219F	234	07	Volume 3b - 431
KC-46	0605221F	83	05	Volume 2 - 531
Large Aircraft IR Countermeasures (LAIRCM)	0401134F	233	07	Volume 3b - 425
Life Support Systems	0604706F	72	05	Volume 2 - 427
Logistics Information Technology (LOGIT)	0708610F	241	07	Volume 3b - 483
Logistics Support Activities	0708012F	240	07	Volume 3b - 479
Long Range Standoff Weapon	0604932F	78	05	Volume 2 - 497
Long Range Strike	0604015F	40	04	Volume 2 - 145
MILSATCOM Terminals	0303601F	185	07	Volume 3b - 51
MQ-1 Predator A UAV	0305219F	215	07	Volume 3b - 251
MQ-9 UAV	0205219F	133	07	Volume 3a - 153
Major T&E Investment	0604759F	98	06	Volume 2 - 669
Manned Destructive Suppression	0207136F	138	07	Volume 3a - 203
Manned Reconnaissance Systems	0305207F	213	07	Volume 3b - 231
Manufacturing Technology Program	0603680F	25	03	Volume 1 - 291
Materials	0602102F	4	02	Volume 1 - 23
Maui Space Surveillance System (MSSS)	0603444F	21	03	Volume 1 - 263
Minimum Essential Emergency Communications Network (MEECN)	0303131F	181	07	Volume 3b - 11

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Minuteman Squadrons	0101213F	126	07	Volume 3a - 101
Mission Planning Systems	0208006F	167	07	Volume 3a - 453
Multi-Platform Electronic Warfare Equipment	0207040F	134	07	Volume 3a - 169
Multi-Service Systems Engineering Initiative	0606323F	109	06	Volume 2 - 729
NATO AGS	0305238F	219	07	Volume 3b - 305
NATO Research and Development	0603790F	33	04	Volume 2 - 93
NAVSTAR Global Positioning System (Space and Control Segments)	0305165F	204	07	Volume 3b - 163
NAVSTAR Global Positioning System (User Equipment) (SPACE)	0305164F	56	04	Volume 2 - 247
NAVSTAR Global Positioning System (User Equipment) (SPACE)	0305164F	203	07	Volume 3b - 155
NUDET Detection System (SPACE)	0305913F	225	07	Volume 3b - 363
Network-Centric Collaborative Targeting	0305221F	217	07	Volume 3b - 293
Next Generation Air Dominance	0207110F	54	04	Volume 2 - 235
NextGen JSTARS	0307581F	95	05	Volume 2 - 643
Nuclear Weapons Modernization	0101125F	92	05	Volume 2 - 617
Operational Support Airlift	0401314F	235	07	Volume 3b - 435
Operationally Responsive Space	0604857F	50	04	Volume 2 - 217
Other Flight Training	0804743F	243	07	Volume 3b - 523
Other Personnel Activities	0808716F	244	07	Volume 3b - 531
Personnel Administration	0901220F	247	07	Volume 3b - 543

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Physical Security Equipment	0603287F	28	04	Volume 2 - 33
Physical Security Equipment	0604287F	62	05	Volume 2 - 305
Polar MILSATCOM (SPACE)	0603432F	30	04	Volume 2 - 59
Polar MILSATCOM (SPACE)	0605432F	88	05	Volume 2 - 585
Pollution Prevention - Dem/Val	0603859F	39	04	Volume 2 - 139
Precision Attack Systems Procurement	0207249F	148	07	Volume 3a - 297
Presidental Aircraft Replacement (PAR)	0401319F	237	07	Volume 3b - 459
RAND Project Air Force	0605101F	99	06	Volume 2 - 677
RQ-4 UAV	0305220F	216	07	Volume 3b - 257
Rapid Cyber Acquisition	0305881F	223	07	Volume 3b - 351
Readiness Training Ranges, Operations and Maintenance	0207604F	93	05	Volume 2 - 629
Region/Sector Operation Control Center Modernization Program	0102326F	130	07	Volume 3a - 139
Requirements Analysis and Maturation	0604337F	44	04	Volume 2 - 175
Requirements Analysis and Maturation	0606017F	107	06	Volume 2 - 721
Rocket Systems Launch Program (SPACE)	0605860F	103	06	Volume 2 - 701
Satellite Control Network (SPACE)	0305110F	193	07	Volume 3b - 105
Security and Investigative Activities	0305128F	199	07	Volume 3b - 139
Seek Eagle	0207590F	163	07	Volume 3a - 425
Service Support to STRATCOM - Space Activities	0105921F	52	04	Volume 2 - 229

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Service Support to STRATCOM - Space Activities	0105921F	131	07	Volume 3a - 143
Shared Early Warning (SEW)	0308699F	228	07	Volume 3b - 381
Small Business Innovation Research	0605502F	100	06	Volume 2 - 683
Small Diameter Bomb (SDB) - EMD	0604329F	63	05	Volume 2 - 311
Space Based Infrared System (SBIRS) High EMD	0604441F	68	05	Volume 2 - 365
Space Control Technology	0603438F	31	04	Volume 2 - 67
Space Fence	0604426F	66	05	Volume 2 - 351
Space Innovation, Integration and Rapid Technology Development	0305174F	207	07	Volume 3b - 175
Space Security and Defense Program	0603830F	35	04	Volume 2 - 101
Space Situation Awareness Operations	0305940F	226	07	Volume 3b - 369
Space Situation Awareness Systems	0604425F	65	05	Volume 2 - 333
Space Superiority Intelligence	0301400F	179	07	Volume 3b - 1
Space Technology	0602601F	9	02	Volume 1 - 113
Space Test Program (STP)	0605864F	104	06	Volume 2 - 705
Space Test and Training Range Development	0606116F	108	06	Volume 2 - 725
Space and Missile Center (SMC) Civilian Workforce	0606392F	110	06	Volume 2 - 733
Space and Missile Test and Evaluation Center	0305173F	206	07	Volume 3b - 171
Spacelift Range System (SPACE)	0305182F	209	07	Volume 3b - 187
Special Tactics / Combat Control	0408011F	238	07	Volume 3b - 467

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Specialized Undergraduate Flight Training	0604233F	59	05	Volume 2 - 265
Strat War Planning System - USSTRATCOM	0101313F	127	07	Volume 3a - 125
Submunitions	0604604F	70	05	Volume 2 - 407
Support Systems Development	0708611F	242	07	Volume 3b - 513
Support to DCGS Enterprise	0305240F	220	07	Volume 3b - 311
Sustainment Science and Technology (S&T)	0603199F	15	03	Volume 1 - 185
Tactical AIM Missiles	0207161F	141	07	Volume 3a - 251
Tactical Air Control Party-Mod	0207444F	158	07	Volume 3a - 385
Tactical Airborne Control Systems	0207418F	155	07	Volume 3a - 371
Tactical Data Networks Enterprise	0604281F	61	05	Volume 2 - 291
Tech Transition Program	0604858F	51	04	Volume 2 - 223
Technology Transfer	0604317F	42	04	Volume 2 - 163
Test and Evaluation Support	0605807F	102	06	Volume 2 - 693
Threat Simulator Development	0604256F	97	06	Volume 2 - 659
Three Dimensional Long-Range Radar (3DELRR)	0207455F	55	04	Volume 2 - 239
USAF Modeling and Simulation	0207601F	164	07	Volume 3a - 431
University Research Initiatives	0601103F	2	01	Volume 1 - 15
WIDEBAND GLOBAL SATCOM (SPACE)	0605433F	89	05	Volume 2 - 593
Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	0203761F	132	07	Volume 3a - 149

Program Element Title	Program Element Number	Line Item	Budget Activity	Page
Wargaming and Simulation Centers	0207605F	165	07	Volume 3a - 441
Weather Service	0305111F	194	07	Volume 3b - 111
Weather System Follow-on	0604422F	45	04	Volume 2 - 185
Wide Area Surveillance	0604445F	116	07	Volume 3a - 19
Wideband Global SATCOM RDT&E (Space)	0603854F	38	04	Volume 2 - 135

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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)

0602201F	AEROSPACE VEHICLE TECHNOLOGIES	In FY 2015, Project 622405 is a new start.

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

0603211F	AEROSPACE TECHNOLOGY DEV/DEMO	In FY 2015, Project 634926 is a new start; efforts transferred from Project 634920, Flight Vehicle Technology Integration, to support DoD priorities in hypersonics demonstration.

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

0207110F	NEXT GENERATION AIR DOMINANCE	In FY 2015, a new BPAC 646007 2030+ Air Dominance AOS is an FY15 New Start.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0603260F	INTELLIGENCE ADVANCED DEVELOPMENT	In FY 2015, Project Number 64537A, Intelligence Analysis Capabilities (IAC), efforts transferred from PE 0603260F (BA5), Intelligence Advanced Development (IAD), Project Number 652053, National Air Intelligence Center, in order to properly align efforts, increase management efficiency, and reduce administrative actions. In FY 2015, Project Number 643479 Advanced Sensor Exploitation, Project Number 643480 Automated Imagery Exploitation, Project Number 643481 Knowledge Based Tech for Intelligence, and Project Number 643482 Science & Tech Intelligence Methodology, transferred to Project Number 64536A, IET, in order to increase management efficiency, reduce administrative actions, and minimize effort duplication. In FY 2015, Project Number 64536A, Intelligence Exploitation Tools (IET), transferred from PE 0603260F Intelligence Advanced Development (IAD), Project Number 643479 Advanced Sensor Exploitation, Project Number 643480 Automated Imagery Exploitation, Project Number 643481 Knowledge Based Tech for Intelligence, and Project Number 643482 Science & Tech Intelligence Methodology, in order to increase management efficiency, reduce administrative actions, and minimize activity duplication. In FY 2015, Project Number 64536A, Intelligence Exploitation Tools (IET), includes four new start efforts: Private Assistant for Individual Relegation (PAIR), Feature and Pattern Recognition and Parsing to Text- Foreign Audio Video Operations (FAVOR) II, Increased SIGINT On-Board Analysis (ISOBA), and Global Architecture for Mission Reporting and Analysis (GAMRA). In FY 2015, Project Number 64537A, Intelligence Analysis Capabilities (IAC), efforts were transferred from PE 0603260F, Intelligence Advanced Development (IAD), Project Number 652053, National Air Intel Center, in order to increase management efficiency, reduce administrative actions, and minimize activity duplication. In FY 2015, Project Number 64537A, IAC, includes a new start effort: Activity Based Intelligence Indications & Warning.
0603287F	PHYSICAL SECURITY EQUIPMENT	In FY 2015, Physical Security Equipment efforts were transferred from PE 0603287F, Physical Security Equipment, Project Number 645121 in BA04 to PE 0604287F, Physical Security Equipment, Project Number 645121 in BA05 in order to align funding into the correct Budget Activity of BA05.
0603438F	SPACE CONTROL TECHNOLOGY	In FY 2015, Project 64A007 Space Range efforts were transferred to PE 0606116F, Space Test and Training Range Development.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0603851F	INTERCONTINENTAL BALLISTIC MISSILE - DEM/VAL	In FY 2015, Project 641022, ICBM Reentry Vehicle Applications is a new start. In FY 2015, Project 641024, ICBM Command & Control (C2) Applications is a new start. In FY 2015, Project 644209, Long Range Planning is a new start.
0604283F	BATTLE MGMT COM & CTRL SENSOR DEVELOPMENT	In FY 2015, Project 645363, MP-RTIP efforts were transferred to PE 0307581F, NextGen JSTARS, Project 650003, JSTARS Recapitalization, in order to consolidate efforts and continue development of the JSTARs Recap.
0604337F	REQUIREMENTS ANALYSIS AND MATURATION	In FY 2015, Project 645349 Developmental Planning efforts were transferred to PE 0606017F Project 666157 Development Planning to improve alignment with the budget activity.
0604422F	WEATHER SYSTEM FOLLOW-ON	In FY 2015, the Weather System Follow-on (WSF) Project 644289, is a New Start.
0105921F	SERVICE SUPPORT TO STRATCOM - SPACE ACTIVITIES	In FY 2015, Project 643833 Joint NavWar Center (JNWC) Space Activities, efforts were transferred to PE 0105921F Service Support to STRATCOM - Space Activities, Project 672486 Joint NAVWAR Center in order to align efforts with Budget Activity 7, Operational System Development.
0604458F	AIR & SPACE OPS CENTER	In FY 2015, PE 0604458F Air & Space Ops Center, Project 644945, AOC Increment 10.2 development efforts were transferred to PE 0605458F, Air & Space Ops Center 10.2, Project 654945, AOC 10.2 Development, in order to align post Milestone B development efforts with Budget Activity 05, System Development & Demonstration (SDD).
0604618F	JOINT DIRECT ATTACK MUNITION	In FY 2015, PE 0604618F transitioned from BA04 to BA07.
0604635F	GROUND ATTACK WEAPONS FUZE DEVELOPMENT	In FY 2015, 645312, Hard Target Void Sensing Fuze, efforts were transferred to PE 0605214F, Ground Attack Weapons Fuze Development, 655313, Hard Target Void Sensing Fuze, in order to properly align efforts with Budget Activity, BA05, System Development & Demonstration (SDD)
0604800F	F-35 - EMD	In FY 2015, the funding in this line was inadvertently loaded into BA04. The Air Force plans to execute the funding in BA05 if appropriated. Refer to Budget Activity 05 PE 0604800F, F-35 - EMD, for justification for this funding.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

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

0307581F	NEXTGEN JSTARS	In FY 2015, Project 650003, JSTARS Recapitalization efforts were transferred from PE 0604283F, BMC2 Sensor Development, Project 645363, MP-RTIP, in order to consolidate efforts and continue development of the JSTARs Recap. This is a new start. In FY 2015, Project 650003, JSTARS Recapitalization efforts were transferred from PE 0207581F, Joint Surveillance/Target Attack Radar System (JSTARS), Project 670003, JSTARS, in order to consolidate efforts and continue development of the JSTARs Recap.
0401318F	CV-22	In FY 2015, Project 654103 CV-22, efforts were transferred to PE 0401318F, CV-22, Project 676033 CV-22 RDT&E Post Production in order to align efforts in Budget Activity 07, Operational System Development, since CV-22 has been fielded.
0603260F	INTELLIGENCE ADVANCED DEVELOPMENT	In FY 2015, Project Number 652053, National Air Intelligence Center, efforts transferred to PE 0603260F (BA4), Intelligence Advanced Development (IAD), Project Number 64537A, Intelligence Analysis Capabilities (IAC), in order to increase management efficiency, reduce administrative actions, and minimize activity duplication.
0604233F	SPECIALIZED UNDERGRADUATE FLIGHT TRAINING	In FY 2015, Project 655340, Advanced Trainer Replacement T-X, efforts were transferred to Program Element 0605223F, Advanced Pilot Training, Project 655340, Advanced Trainer Replacement T-X, to improve transparency on ACAT I acquisition programs.
0604287F	PHYSICAL SECURITY EQUIPMENT	In FY 2015, Physical Security Equipment efforts were transferred from PE 0603287F, Physical Security Equipment, Project Number 645121 in BA04 to PE 0604287F, Physical Security Equipment, Project Number 645121 in BA05 in order to align funding into the correct Budget Activity of BA05.
0604425F	SPACE SITUATION AWARENESS SYSTEMS	In FY 2015, Project 65A009 Space Fence efforts were transferred to PE 0604426F.
0604426F	SPACE FENCE	In FY 2015, Project 65A009, Space Fence efforts were transitioned from PE 0604425F - Space Situational Awareness Systems, Project 65A009 in order to improve transparency for ACAT I acquisition programs.
0604617F	AGILE COMBAT SUPPORT	In FY 2015, Project 652895, CE Readiness, includes a New Start for Airfield Protection. In FY 2015, Project 654910, Aeromedical Readiness, includes a New Start for Non-Invasive Warming and Cooling Device (NIWCD).

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0604800F	F-35 - EMD	In FY 2015, $4.976M of FY15 and $4.979M of FY16 funding for this effort was inadvertently loaded into BA04. If appropriated the Air Force plans to execute the funding in BA05.
0604851F	INTERCONTINENTAL BALLISTIC MISSILE - EMD	In FY 2015, Project 655037, Support Equipment, efforts were transferred to PE 0101213F, Minuteman Squadrons, Project 672985, MM Support Equip, and Project 672984, MM III Baseline Support in order to consolidate ICBM investment activities under a common PE. In FY 2015, Project 655081, ICBM Crypto, efforts were transferred to PE 0101213F, Minuteman Squadrons, Project 672986, MM Crypto Mods in order to consolidate ICBM investment activities under a common PE
0604932F	LONG RANGE STANDOFF WEAPON	In FY 2015, the LRSO program was delayed three years for higher Air Force priorities.
0605030F	JOINT TACTICAL NETWORK CENTER (JNTC)	In FY 2015, Project 655068, Joint Tactical Radio System, efforts were transferred from PE 0604280F Joint Tactical Radio System (JTRS), Project 655068, Joint Tactical Radio System, to in order to improve transparency of ACAT 1 Acquisition programs.
0605214F	GROUND ATTACK WEAPONS FUZE DEVELOPMENT	In FY 2015, 655313, Hard Target Void Sensing Fuze, efforts were transferred from PE 0604635F, Ground Attack Weapons Fuze Development, 645312, Hard Target Void Sensing Fuze, in order to properly align the funds in the correct Budget Activity, BA05, which supports Engineering, Manufacturing, and Development (EMD).
0605223F	ADVANCED PILOT TRAINING	In FY2015, Project 655340, Advanced Trainer Replacement T-X, efforts were transferred from Program 0604233F, Specialized Undergraduate Flight Training, Project 655340, Advanced Trainer Replacement T-X, in order to improve transparency of ACAT I acquisition programs.
0605433F	WIDEBAND GLOBAL SATCOM (SPACE)	In FY 2015, Project 657107, WGS Space Systems Resiliency Upgrade, is a New Start.
0605458F	AIR & SPACE OPS CENTER 10.2 RDT&E	In FY 2015, PE 0605458F, Air & Space Ops Center 10.2, project 654945, AOC 10.2 Development, efforts were transferred from PE 0604458F, Air & Space Ops Center, project 644945, AOC Increment 10.2 development, in order to align post Milestone B development efforts with funding in RDT&E Budget Activity 05, System Development & Demonstration (SDD).

PROGRAM ELEMENT COMPARISON SUMMARY

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

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

0308602F	ENTEPRISE INFORMATION SERVICES (EIS)	In FY 2015, project 675046 Systems Engineering & Integration, efforts were transferred from PE 0303141F, Global Combat Support Systems (GCSS) to project 66ACSI, Acquisition and Command Support (ACSI), PE 0308602F, Enterprise Information Services (EIS), in order to provide better visibility of costs associated with evolution to Common Computing Environment (CCE).
0606017F	REQUIREMENTS ANALYSIS AND MATURATION	In FY 2015, Project 666157 Developmental Planning efforts were transferred from PE 0604337F Project 645349 Development Planning to improve alignment with the budget activity.
0606116F	SPACE TEST AND TRAINING RANGE DEVELOPMENT	In FY 2015, Project 666156 Space Test and Training Range Development efforts were transferred from PE 0603438F, Space Test and Training Range Development Project 64A007 Space Range to improve alignment with budget activity.
0606323F	MULTI-SERVICE SYSTEMS ENGINEERING INITIATIVE	In FY 2015, Project 668101, MSSE and JIAMD Capability Initiative, was terminated. Per the Ballistic Missile Defense System (BMDS) Acquisition Decision Memorandum (ADM) of 8 May 2013, the Missile Defense Agency (MDA) assumed technical authority responsibility of air and missile defense integration activities.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

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

0101213F MINUTEMAN SQUADRONS

In FY 2015, Project 672983, Minuteman (MM) Ground and Comm Equipment includes new start efforts for Automatic Switching Unit (ASU), Ultra-High Frequency (UHF) Receiver, and Launch Control Center (LCC) Block Upgrades.

In FY 2015, Project 672984, MM III Baseline Support includes new start efforts for Modular Mechanical Ordnance Destruct System (MMODS), Ground Test Upgrades, and Baseline Support.

In FY 2015, Project 672984, MM III Baseline Support, efforts were transferred from PE 0604851F, Intercontinental Ballistic Missile (ICBM) - Engineering Manufacturing Development (EMD), Project 655037, Support Equipment, in order to consolidate ICBM investment efforts under a common PE. Specific efforts transferred include the Instrumentation Wafer Replacement Program and Signal Conditioner Monitor. These programs were consolidated into the MM III Instrumentation Wafer Replacement Program (MMIWRP).

In FY 2015, Project 672985, MM Support Equipment includes new start effort for the Re-Entry Support Equipment Replacement (RSERP).

In FY 2015, Project 672985, MM Support Equip, efforts were transferred from PE 0604851F, ICBM - EMD, Project 655037, Support Equipment, in order to consolidate ICBM investment efforts under a common PE. Specific efforts transferred include the Reentry Field Support Equipment (RFSE), Code System Media (CSM), Reentry Support Equipment Replacement Program (RSERP), Strategic Targeting Applications Computer System (STACS), and Transporter Erector Replacement Program (TERP).

In FY 2015, Project 672986, MM Crypto Mods efforts were transferred from PE 0604851F, ICBM - EMD, Project 655081, ICBM Crypto in order to consolidate ICBM investment efforts under a common PE. Specific efforts transferred include the ICBM Crypto Unit II (ICU II).

In FY 2015, Project 672987, MM Ops Equip includes new start effort for Guidance Modernization.

In FY 2015, Project 672987, MM Ops Equip, Solid Rocket Motor Modernization (SRMM) efforts transferred from PE 0604851F, ICBM - EMD, Project 657010, Ops Equipment.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0105921F	SERVICE SUPPORT TO STRATCOM - SPACE ACTIVITIES	In FY 2015, Project 672486 Joint NAVWAR Center (JNWC) Space Activities, efforts were transferred from PE 0105921F Service Support to STRATCOM - Space Activities, Project 643833 Joint NavWar Center in order to align efforts with Budget Activity 7, Operational System Development.
0203761F	WARFIGHTER RAPID ACQUISITION PROCESS (WRAP) RAPID TRANSITION FUND	In FY 2015, Project 674936, Warfighter Rapid Acquisition Program, was terminated.
0207131F	A-10 SQUADRONS	In FY 2015, efforts in Project number 674809, were completed. The entire A-10 fleet is planned for divestiture beginning In FY 2015.
0207133F	F-16 SQUADRONS	In FY 2015, Combat Aviation Programmed Extension Suite (CAPES) is terminated.
0207134F	F-15E SQUADRONS	In FY 2015, Infrared Search and Track (IRST) is a new start. In FY 2015, PE 0207134F Project 670131 Initial Operation Test and Evaluation, EPAWSS efforts were transferred to PE 0207171F Project 676038 EPAWSS.
0207138F	F-22A SQUADRONS	In FY15, Project 674785 efforts transferred to Project 674788 F-22 Tactical Mandates, formerly known as F-22 Mandates.
0207142F	F-35 SQUADRONS	In FY 2015, BPAC 676011, JSF DUAL CAPABLE AIRCRAFT is a new start.
0207171F	F-15 EPAWSS	In FY 2015, Project 676038 EPAWSS efforts were transferred from PE 0207134F Project 670131 Initial Operation Test and Evaluation.
0207410F	AIR AND SPACE OPERATIONS CENTER (AOC)	In FY 2015, PE 0604458F Air & Space Ops Center project 644945 AOC Increment 10.2 development efforts were transferred to PE 0605458F Air & Space Ops Center 10.2 RDT&E project 654945 AOC 10.2 Development, to align post Milestone B development efforts with funding in RDT&E Budget Activity 05, System Development & Demonstration (SDD).
0207449F	COMMAND AND CONTROL (C2) CONSTELLATION	In FY 2015, Project 675078, Horizontal Integration (HI), was terminated.

PROGRAM ELEMENT (BY BUDGET ACTIVITY)

0207581F	JOINT SURVEILLANCE/TARGET ATTACK RADAR SYSTEM (JSTARS)	In FY 2015, Project 670003, JSTARS efforts were transferred to PE 0307581F, NextGen JSTARS, Project 650003, JSTARS Recapitalization , in order to consolidate efforts and continue development of the JSTARs Recap.
0303141F	GLOBAL COMBAT SUPPORT SYSTEM	In FY 2015, components of project 675046, Systems Engineering & Integration, efforts were transferred from PE 0303141F, Global Combat Support Systems (GCSS) to project 66ACSI, ACSI, PE 0308602F, Enterprise Information Services, in order to provide better visibility of costs associated with evolution to a Common Computing Environment (CCE).
0305205F	ENDURANCE UNMANNED AERIAL VEHICLES	In FY 2015, 675372, Integrated Sensor is Structure, was completed.
0306250F	CYBER OPERATIONS TECHNOLOGY DEVELOPMENT	In FY 2015, Project Number 676002, Cyber Systems Modernization, is a new start.
0401132F	C-130J PROGRAM	In FY 2015, the Project 675062 C-130J Trainers completes.
0401314F	OPERATIONAL SUPPORT AIRLIFT	In FY 2015 and beyond, Project 675355 Presidential Aircraft Recapitalization efforts will be executed in PE0401319F, Project 655250, Presidential Aircraft Recap in order to improve transparency for ACAT I acquisition programs.
0401318F	CV-22	In FY 2015, PE 0401318F, Project 654103 CV-22, efforts were transferred to PE 0401318F, CV-22, Project 676033 CV-22 RDT&E Post Production in order to align efforts in Budget Activity 07, Operational System Development, since the CV-22 has been fielded.
0401319F	PRESIDENTIAL AIRCRAFT REPLACEMENT (PAR)	In FY 2015, Project 655250 Presidential Aircraft Recap efforts were transferred from PE 0401314F, Project 675355, Presidential Aircraft Recapitalization in order to improve transparency for ACAT I acquisition programs.
0604618F	JOINT DIRECT ATTACK MUNITION	In FY 2015, Project 674138 JDAM Development efforts were transferred from Budget Activity 4.
0901538F	FINANCIAL MANAGEMENT INFORMATION SYSTEMS DEVELOPMENT	In FY 2015, Project 675178 DEAMS Inc 2 is a new start.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	323.869	373.151	314.482	-	314.482	341.535	344.919	346.508	352.224	Continuing	Continuing
613001: *Physics and Electronics*	-	100.641	107.174	91.817	-	91.817	99.235	98.821	99.699	101.363	Continuing	Continuing
613002: *Aerospace, Chemical and Material Sciences*	-	97.557	116.611	102.200	-	102.200	112.244	113.666	113.880	115.695	Continuing	Continuing
613003: *Mathematics, Information and Life Sciences*	-	106.740	119.873	97.624	-	97.624	105.409	106.673	107.088	108.886	Continuing	Continuing
613004: *Education and Outreach*	-	18.931	29.493	22.841	-	22.841	24.647	25.759	25.841	26.280	Continuing	Continuing

The FY 2015 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, sensor, and support 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	361.787	373.151	379.833	-	379.833
Current President's Budget	323.869	373.151	314.482	-	314.482
Total Adjustments	-37.918	-	-65.351	-	-65.351
• Congressional General Reductions	-0.511	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-7.554	-			
• Other Adjustments	-29.853	-	-65.351	-	-65.351

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DOD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613001 / *Physics and Electronics*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
613001: *Physics and Electronics*	-	100.641	107.174	91.817	-	91.817	99.235	98.821	99.699	101.363	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Complex Electronics and Fundamental Quantum Processes	46.114	49.209	42.154
Description: Scientific focus areas are atomic and molecular physics, photonics, quantum electronic solids, adaptive multi-mode sensing and ultra-high speed electronics, semiconductor and electromagnetic materials, and optoelectronics.			
FY 2013 Accomplishments: Detected ripples of electrons along the surface of graphene which is an important step toward using plasmons to process and transmit quantum information. Explored a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, dielectric and magnetic materials, semiconductor lasers, memristive systems, new classes of high-temperature superconductors, quantum dots, quantum wells and graphene. Included generating and controlling quantum states, such as superposition and entanglement, in photons and ultracold atoms and molecules.			
FY 2014 Plans: Explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, dielectric 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 ultracold atoms and molecules.			
FY 2015 Plans: Continue to explore a wide range of complex materials and devices, including non-linear optical materials, photonics, optoelectronics, meta-materials, cathodes, dielectric and magnetic materials, memristive systems, new classes of high-			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613001 / *Physics and Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
temperature superconductors, quantum dots, quantum wells and graphene. Includes generating and controlling quantum states, such as superposition and entanglement, in photons and ultracold atoms and molecules.			
Title: Plasma Physics and High Energy Density Non-Equilibrium Processes ***Description:*** Scientific focus areas are plasma, electro-energetic physics and space sciences. ***FY 2013 Accomplishments:*** Discovered a new technique using metamaterials to localize electromagnetic waves into ultra-subwavelength scales and its dramatically reduced size which may lead to high density electromagnetic sources. 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 2014 Plans:*** Explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing 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 2015 Plans:*** Continue to explore a wide range of activities characterized by processes sufficiently energetic to require understanding and managing plasma phenomenology and the non-linear response of materials to high electric and magnetic fields. Includes space weather, plasma discharges, RF propagation, RF-plasma interaction, and high-power, beam-driven microwave devices.	20.296	21.578	18.492
Title: Lasers and Optics, Electromagnetics, Communication and Signal Processing ***Description:*** Scientific focus areas are physical mathematics and applied analysis, novel computational methods, dynamics sensing capability, electromagnetics, remote sensing and imaging physics, and surveillance and navigation. ***FY 2013 Accomplishments:*** Invented a novel microscale mechanical switch of light on a silicon chip that could increase Internet download speeds. 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 of the phenomenology of lasers including high energy lasers, non-linear optics, and ultra-short pulse laser science. Included the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals. ***FY 2014 Plans:***	34.231	36.387	31.171

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613001 / *Physics and Electronics*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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, non-linear optics, and ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals. ***FY 2015 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 ultra-short pulse laser science. Includes the development of sophisticated mathematics and algorithm development for extracting information from complex and/or sparse signals.			
Accomplishments/Planned Programs Subtotals	100.641	107.174	91.817

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613002 / *Aerospace, Chemical and Material Sciences*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
613002: *Aerospace, Chemical and Material Sciences*	-	97.557	116.611	102.200	-	102.200	112.244	113.666	113.880	115.695	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Aero Structure Interactions and Control	27.942	33.567	29.419
Description: Scientific focus areas are high temperature aerospace materials, hypersonics, aerothermodynamics and turbulence, and flow interactions and control.			
FY 2013 Accomplishments: Developed real-time simulations with pilot inputs that provided realistic brownout predictions, and permitted the development of piloting strategies to mitigate brownout. 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, material properties, high-performance structures, and thermodynamics.			
FY 2014 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, material properties, high-performance structures, and thermodynamics.			
FY 2015 Plans: 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			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613002 / *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
synergy gained from an interdisciplinary look at multiple technologies and the integration of core disciplines of fluid mechanics, high-performance 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 2013 Accomplishments:*** Discovered that microscale roughening of a surface can dramatically enhance its transfer of heat which also provides a theoretical framework for analyzing thermal behavior. 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 2014 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 2015 Plans:*** Continue to exploit technological innovations and develop potentially revolutionary technologies by integrating core disciplines of combustion, plasma dynamics, chemistry, hybrid simulation, and structures. 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.	34.373	41.002	35.935
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 2013 Accomplishments:*** Developed the first synthetic material that can both sense subtle pressure and heal itself when torn or cut. 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 while decreasing weight and volume. Explored complex materials, microsystems, and structures that incorporate	35.242	42.042	36.846

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613002 / *Aerospace, Chemical and Material Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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:*** Investigate multifunctional materials and structures composed of different classes of materials, both organic and inorganic, 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 2015 Plans:*** Continue to investigate multifunctional materials and structures composed of inorganic 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 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	97.557	116.611	102.200

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613003 / *Mathematics, Information and Life Sciences*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
613003: *Mathematics, Information and Life Sciences*	-	106.740	119.873	97.624	-	97.624	105.409	106.673	107.088	108.886	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Information and Complex Networks	28.893	32.598	26.548
Description: Scientific focus areas are systems and software, information operations and security, information fusion, and complex networks.			
FY 2013 Accomplishments: Developed algorithm to analyze software, network, and hardware in a dynamic integrated fashion, and allow prediction and management of large infrastructures to meet specific mission objectives. 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 2014 Plans: Design and analyze techniques to enable reliable and secure exchange of information and predictable operation of networks and systems, including hardware and software interactions. 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 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Developed a formal methodology for identifying sensory neural circuits in a brain, enabling new types of high-speed, brain-inspired, information processing. 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 2014 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 2015 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 to model individual and group cognitive processing and decision making.	20.896	23.428	19.080
Title: Dynamical Systems, Optimization, and Control ***Description:*** Scientific focus areas are computational mathematics, dynamics and control, and optimization and discrete mathematics. ***FY 2013 Accomplishments:*** Developed a algorithm to dynamically calculate risk for autonomous systems, such as unmanned aircraft, providing a framework and criteria for the design and testing of trustworthy missions. Developed new scientific concepts supported by rigorous analysis	30.363	34.041	27.722

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613003 / *Mathematics, Information and Life Sciences*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2014 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. Develop novel adaptive control strategies for coordinating heterogeneous, autonomous, or semi-autonomous aerospace vehicles in uncertain, information rich, dynamically changing, adversarial, and networked environments. ***FY 2015 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.			
Title: Natural Materials and Systems ***Description:*** Scientific focus areas are renewable energy, natural materials and nature inspired systems. ***FY 2013 Accomplishments:*** Created a material that repels liquid, including blood and oil, and does so under harsh conditions like high pressure and freezing temperatures. 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 2014 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 2015 Plans:*** Continue to investigate multi-disciplinary approaches for studying 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.	26.588	29.806	24.274
Accomplishments/Planned Programs Subtotals	106.740	119.873	97.624

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 1	R-1 Program Element (Number/Name) PE 0601102F / *Defense Research Sciences*	Project (Number/Name) 613004 / *Education and Outreach*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
613004: *Education and Outreach*	-	18.931	29.493	22.841	-	22.841	24.647	25.759	25.841	26.280	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Outreach to International S&T Community	8.266	12.808	9.919
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 2013 Accomplishments: Collaborated with Italy and Spain to create a material that catalyzes the burning of methane 30 times better than currently available catalysts. Leveraged international expertise and support international technology liaison missions to identify and maintain awareness of foreign science and technology developments. Explored current foreign investments and influence 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 provide primary interface to coordinate international S&T participation among DoD organizations.			
FY 2014 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 2015 Plans: 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			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 1	**R-1 Program Element (Number/Name)** PE 0601102F / *Defense Research Sciences*	**Project (Number/Name)** 613004 / *Education and Outreach*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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.			
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 2013 Accomplishments:*** Awarded 41 grants through the Air Force's Young Investigator Research Program and supported 84 post-doctoral researchers. 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 2014 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 2015 Plans:*** Continue to 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.	10.665	16.685	12.922
Accomplishments/Planned Programs Subtotals	18.931	29.493	22.841

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601103F / *University Research Initiatives*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	125.398	138.333	127.079	-	127.079	145.695	147.395	150.049	152.328	Continuing	Continuing
615094: *University Research Initiatives*	-	125.398	138.333	127.079	-	127.079	145.695	147.395	150.049	152.328	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	141.153	138.333	140.738	-	140.738
Current President's Budget	125.398	138.333	127.079	-	127.079
Total Adjustments	-15.755	-	-13.659	-	-13.659
• Congressional General Reductions	-0.186	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.973	-			
• Other Adjustments	-11.596	-	-13.659	-	-13.659

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DOD priorities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601103F / *University Research Initiatives*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Multidisciplinary University Research Initiative	76.248	76.776	70.530
Description: Promote fundamental, multi- and interdisciplinary science and engineering research projects involving multiple principle investigators. ***FY 2013 Accomplishments:*** Funded 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. Awarded seven grants totaling $67.5M involving 32 academic institutions. 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. Continued 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. ***FY 2015 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	36.277	45.927	42.190
Description: Support post-graduate, graduate, and undergraduate education in science and engineering disciplines at U.S. universities. ***FY 2013 Accomplishments:*** Awarded highly competitive NDSEG fellowships to 181 scholars. Continued to support competitive awards for graduate and undergraduate research experiences, including those established under the Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE) program. Continued funding for awards initiated under prior year DoD programs. ***FY 2014 Plans:***			

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601103F / *University Research Initiatives*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2015 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 2013 Accomplishments:*** Awarded 29 grants totaling $12.7M on a competitive basis under the Defense University Research Instrumentation Program (DURIP) to 26 U.S. universities to acquire state-of-the-art, high technology instrumentation and infrastructure to enhance research and educational capabilities. ***FY 2014 Plans:*** 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 2015 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.	12.873	15.630	14.359
Accomplishments/Planned Programs Subtotals	125.398	138.333	127.079

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601103F / *University Research Initiatives*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*					R-1 Program Element (Number/Name) PE 0601108F / *High Energy Laser Research Initiatives*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	11.614	13.286	12.929	-	12.929	13.870	14.281	14.537	14.739	Continuing	Continuing
615097: *High Energy Laser Research Initiatves*	-	11.614	13.286	12.929	-	12.929	13.870	14.281	14.537	14.739	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	13.094	13.286	13.275	-	13.275
Current President's Budget	11.614	13.286	12.929	-	12.929
Total Adjustments	-1.480	-	-0.346	-	-0.346
• Congressional General Reductions	-0.017	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.380	-			
• Other Adjustments	-1.083	-	-0.346	-	-0.346

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: HEL Devices	7.314	8.406	8.203
Description: Improve the fundamental understanding of HEL sources, to include solid state, free electron, and gas laser technologies.			

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601108F / *High Energy Laser Research Initiatives*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Continued development of innovative laser technologies including diode-pumped alkali, short-pulse, free electron, fiber and solid state laser technologies. Continued 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. ***FY 2015 Plans:*** Continue innovative laser technologies in diode-pumped alkali, short-pulse, free electron, fiber and solid state laser technologies. Continue overseas efforts to leverage international technology advancements. Conduct a proposal call to Universities for advanced laser research initiatives.			
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 2013 Accomplishments:*** Continued research on innovative beam control architectures. Continued 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. ***FY 2015 Plans:*** Continue research on innovative beam control architectures. Continue overseas efforts to leverage international technology advancements. Conduct a proposal call to Universities for advanced beam control initiatives.	3.550	4.130	3.906
Title: HEL Education ***Description:*** Fund educational grants intended to stimulate interest in HELs among students. ***FY 2013 Accomplishments:***	0.750	0.750	0.820

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601108F / *High Energy Laser Research Initiatives*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 supported continuing education for professionals in the HEL field. ***FY 2014 Plans:*** 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 support continuing education for professionals in the HEL field. ***FY 2015 Plans:*** 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 support continuing education for professionals in the HEL field.			
Accomplishments/Planned Programs Subtotals	11.614	13.286	12.929

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602102F / *Materials*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	111.177	120.846	105.680	-	105.680	126.589	127.043	133.440	130.897	Continuing	Continuing
624347: *Materials for Structures, Propulsion, and Subsystems*	-	60.945	64.381	34.776	-	34.776	47.697	44.806	45.524	44.472	Continuing	Continuing
624348: *Materials for Electronics, Optics, and Survivability*	-	25.976	30.302	28.693	-	28.693	34.900	35.326	35.864	34.489	Continuing	Continuing
624349: *Materials Technology for Sustainment*	-	24.256	26.163	42.211	-	42.211	43.992	46.911	52.052	51.936	Continuing	Continuing

The FY 2015 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 three projects that develop: structural, propulsion, and sub-systems materials and processes technologies; electronic, optical, and survivability materials and processes technologies; and sustainment materials, processes technologies, and advanced non-destructive inspection methodologies. 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 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary materials technologies.

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	114.166	116.846	116.504	-	116.504
Current President's Budget	111.177	120.846	105.680	-	105.680
Total Adjustments	-2.989	4.000	-10.824	-	-10.824
• Congressional General Reductions	-0.236	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	9.000	4.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.454	-			
• Other Adjustments	-10.299	-	-10.824	-	-10.824

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Project: 624347: *Materials for Structures, Propulsion, and Subsystems*		
Congressional Add: *Nanotechnology Research*	8.235	4.000
Congressional Add Subtotals for Project: 624347	8.235	4.000
Congressional Add Totals for all Projects	8.235	4.000

Change Summary Explanation

Increase in FY13 Congressional Adds for enhanced efforts in nanotechnology research.

Decrease in FY13 Other Adjustments was due to Sequestration.

Increase in FY14 Congressional Adds for enhanced efforts in nanotechnology research.

Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / *Materials*	Project (Number/Name) 624347 / *Materials for Structures, Propulsion, and Subsystems*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
624347: *Materials for Structures, Propulsion, and Subsystems*	-	60.945	64.381	34.776	-	34.776	47.697	44.806	45.524	44.472	Continuing	Continuing

The FY 2015 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 concurrently develops advanced processing methods to enable adaptive processing of aerospace materials.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Ceramics and Composites	26.613	31.381	20.500
Description: Develop ceramic, ceramic matrix composite, and hybrid materials technologies for performance and supportability improvement in propulsion systems and high temperature aerospace structures.			
FY 2013 Accomplishments: Developed next generation high temperature organic and ceramic matrix composite material systems for AF weapon systems. Initiated advanced processing methods and model development for advanced fibers, interface coatings, matrices, and environmental barrier coatings used in fabrication of composite materials. Conducted experimental tests to assess material behavior and time-dependent degradation in relevant environments. Incorporated hybrid approaches (materials and processes) to develop optical and radio frequency communication system apertures. Initiated the development of advanced electromagnetic and laser protection technologies to structurally harden aerospace structures. Initiated the transition of behavior and life prediction models of organic matrix composites.			
FY 2014 Plans: Continue development of next generation high temperature organic and ceramic matrix composite material systems for Air Force weapon systems. Continue development of advanced processing methods and validate process models for organic matrix composites. Initiate process models for ceramic matrix composites. Conduct durability assessments of composite			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
material behavior to gain understanding of time-dependent degradation. Develop novel hybrid approaches for optical and radio frequency communication system aperture applications. Develop advanced electromagnetic and laser protection technologies for structurally harden aerospace structures. Continue the transition of behavior and life prediction models of organic matrix composites. ***FY 2015 Plans:*** Demonstrate new advanced processing methods, coating technologies, and behavioral life prediction for higher temperature capable organic and ceramic matrix composites. Validate severe environment durability of advanced composite systems via mechanical testing. Continue to advance the development of new ceramic and organic matrix composite materials and processes with higher temperature capability for propulsion systems and aerospace structures. Validate and demonstrate hybrid materials and processes for applications in combined optical and radio frequency communication system apertures. Demonstrate and validate advanced electromagnetic and laser protection technologies for aerospace structures.			
Title: Metals ***Description:*** Develop lightweight and high temperature metallics, life prediction, and metals processing technologies for increased affordability, durability, and reliability. ***FY 2013 Accomplishments:*** Transitioned advanced blade and disk system into advanced turbine engine systems. Demonstrated advanced computation methods to support material development and characterization modeling. Demonstrated quantitative, predictive models for performance of metallic based thermal management systems. Analyzed relationships between microstructure, processing, functional properties, and performance of metallic, hybrid, nanoscale, and composite materials. Initiated development analysis techniques for understanding and mitigating residual stress in nickel-base superalloys. ***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 gradient metallic materials. Continue development of analysis of residual stress in nickel-base superalloys. Initiate development of integrated material/manufacturing and component analysis for life management and development of structural materials innovative research. Initiate development of next generation turbine engine disk. ***FY 2015 Plans:*** Validate repeatability of advanced computation methods to support material development and characterization modeling. Demonstrate quantitative, predictive models for performance of metallic based thermal management systems. Continue to analyze relationships between microstructure, processing, functional properties, and performance of metallic, hybrid, nanoscale,	13.843	15.559	10.750

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
and gradient metallic materials. Demonstrate analysis techniques for understanding and mitigating residual stress in nickel-base superalloys. Continue development of integrated material/manufacturing and component analysis for life management and development of structural materials innovative research. Continue development of next generation turbine engine disk.			
Title: Thermal Protection Materials ***Description:*** Develop and evaluate lightweight, active, adaptive, multifunctional, high temperature, and durable material systems for extreme environments and hypersonic applications. ***FY 2013 Accomplishments:*** Developed advanced metallic, oxide, and ceramic materials for hypersonic weapon systems. Initiated novel materials and processing methods to fabricate thermal protection systems for expendable hypersonic applications such as control surfaces, leading edges, and acreage designs. Developed unique experimental techniques to assess mechanical properties and time-dependent behavior of advanced metallic and ceramic materials systems. Fabricated ultra-high temperature ceramics using field assisted sintering technology and evaluated resulting ceramics in hypersonic experimental propulsion rig. Developed computational models to assess environmental degradation of materials in a hypersonic environment. ***FY 2014 Plans:*** Continue to develop advanced metallic, oxide, and ceramic materials for hypersonic weapon systems. Initiate novel materials and processing methods to fabricate structurally integrated thermal protection systems for expendable hypersonic applications such as control surfaces, leading edges, and acreage designs. Develop unique experimental techniques to assess mechanical properties and time-dependent behavior. Incorporate solutions for optical and radio frequency communication system aperture applications on hypersonic systems. Continue validating performance of fabricated ultra-high temperature ceramics using field assisted sintering technology using a hypersonic experimental propulsion rig. Develop and validate computational models to assess environmental degradation of materials in a hypersonic environment. ***FY 2015 Plans:*** Refine and improve upon the processing methods to fabricate structurally integrated thermal protection systems for expendable hypersonic applications. Develop unique experimental techniques to assess mechanical properties and time-dependent behavior. Validate material properties and performance meets design needs for control surfaces, leading edges and acreage. Develop and validate computational models to assess environmental degradation of materials in a hypersonic environment.	6.710	7.349	3.526
Title: Nanomaterials and Metamaterials ***Description:*** Develop nanostructured materials and nanoscale architectures to address electromagnetic applications. Develop metamaterials for sensors, antennas, electronics, and optical elements. ***FY 2013 Accomplishments:***	5.544	6.092	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624347 / *Materials for Structures, Propulsion, and Subsystems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed computation materials science techniques and models to characterize nanomaterials. Analyzed nanoscale materials to understand and characterize the transport of mass, momentum, and energy at the atomic level. Developed and demonstrated concepts for RF passive metamaterials-based components. ***FY 2014 Plans:*** Validate computation materials science techniques and models to characterize nanomaterials. Continue to demonstrate concepts for RF passive metamaterials-based components and develop metamaterials for multiple applications. Initiate development of electromagnetic hardened conformal array. ***FY 2015 Plans:*** Efforts transferred to project 624348 (Nanostructured and Biological Materials).			
Accomplishments/Planned Programs Subtotals	52.710	60.381	34.776

	FY 2013	FY 2014
Congressional Add: Nanotechnology Research	8.235	4.000
FY 2013 Accomplishments: Conducted Congressionally-directed effort.		
FY 2014 Plans: Conduct Congressionally-directed effort.		
Congressional Adds Subtotals	8.235	4.000

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / *Materials*	Project (Number/Name) 624348 / *Materials for Electronics, Optics, and Survivability*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
624348: *Materials for Electronics, Optics, and Survivability*	-	25.976	30.302	28.693	-	28.693	34.900	35.326	35.864	34.489	Continuing	Continuing

The FY 2015 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 (IR) 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. 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, high power microwave, and lightning strike protection.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Infrared Detector Materials	8.438	9.648	9.443
Description: Develop IR detector materials and processes technologies for performance, affordability, and operational capability of surveillance, tracking, targeting, and situational awareness systems.			
FY 2013 Accomplishments: Transitioned optimized design of 2k x 2k IR detectors with integrated circuits, processing, and packaging for enhanced focal plane array yields. Continued to develop a super-lattice based material system for use in the detector elements of very-long wavelength IR detector focal plane arrays. Operated a mid-wave IR (MWIR) focal plane array at temperatures above 200 Kelvin to demonstrate overcoming the challenge of cryogenic cooling requirements. Transitioned mid-wavelength materials for high temperature, low-noise sensing for use on low power systems. Demonstrated models of materials optical/infrared behavior for low observable (LO), intelligence, surveillance, and reconnaissance (ISR), and other applications. Initiated development of nanoscale materials for use in producing detectors. Developed 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 nanoscale materials for use in producing detectors. Utilize computational materials science to improve performance prediction			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
models. Continue to develop inorganic quantum materials for aerospace applications. Initiate development of short wave IR detector materials and hyperspectral long wave IR materials. Initiate development of radio frequency (RF)/IR photonics for compact air vehicle applications. ***FY 2015 Plans:*** Continue to develop materials for use in high resolution MWIR applications. Continue to develop materials to support and provide persistent air ISR. Validate and demonstrate models of materials optical/IR behavior for LO, ISR, and other applications. Validate and demonstrate nanoscale materials for use in producing detectors. Continue to utilize computational materials science to improve performance prediction models. Validate and demonstrate inorganic quantum materials for aerospace applications. Continue development of short wave IR detector materials and hyperspectral long wave IR materials. Continue development of RF/IR photonics for compact air vehicle applications.			
Title: Directed Energy Hardened Materials ***Description:*** Develop and demonstrate technologies to enhance the safety, survivability, and mission effectiveness of aircrews, sensors, viewing systems, and related assets. ***FY 2013 Accomplishments:*** Developed and demonstrated materials and technologies to protect against directed energy threats. Projects included 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. Developed materials for high energy laser interactions. Utilized computational materials science to enhance multi-scale modeling. Developed 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 materials science to enhance multi-scale modeling. Continue to develop materials and processes for hardening and optical materials applications. Initiate development of photonic enabled RF phased arrays and tunable inductors/large area films. ***FY 2015 Plans:*** Demonstrate repeatability 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	10.750	12.175	10.817

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
in airborne, space, and personnel systems. Validate materials for high energy laser interactions. Utilize computational materials science to enhance multi-scale modeling. Demonstrate materials and processes for hardening and optical materials applications. Continued development of photonic enabled RF phased arrays and tunable inductors/large area films.			
Title: Laser Source Materials ***Description:*** Develop materials to enable higher performance lasing media, new laser architectures, optical isolators, beam steering, and other high energy laser components for directed energy. ***FY 2013 Accomplishments:*** Developed and demonstrated reliable materials and processes to optimize components for compact, lightweight, high power microwave directed energy applications. Developed materials and processes for Polymeric Energy Conversion. Demonstrated materials for improved laser source components operating in the mid-infrared range. Developed materials with tailorable properties for beam steering in the newly accessible W band. Demonstrated materials processes for fabricating new laser beam scanning devices that utilize electro-optic polymers to enable high-speed beam steering. Developed and demonstrate materials that increase high energy laser efficiency and output. Utilized computational materials science to improve performance predictions and shorten design cycle time. ***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. 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. ***FY 2015 Plans:*** Demonstrate materials with tailorable properties for beam steering in the newly accessible W band. Validate and demonstrate materials processes for fabricating new laser beam scanning devices that utilize electro-optic polymers to enable high-speed beam steering.	3.044	3.825	1.184
Title: Nanostructured and Biological Materials ***Description:*** Develop enabling and foundational biotechnologies for guidance and control, rapid tagging, tracking, and identification of targets, and bio-integrated electronics and sensing. ***FY 2013 Accomplishments:***	3.744	4.654	7.249

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Develop biological engineering methods for sensors and electro-optic devices for complex hybrid materials. Used pervasive computational materials science to model guided experiments and to enable rapid in-situ experimental data acquisition. ***FY 2014 Plans:*** 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. Continue to develop and demonstrate reliable materials and processes to optimize components for compact, lightweight, multifunctional devices for use in autonomy. Continue to develop materials and processes for writing and printing robust electronics on varied flexible & stretchable substrates, and the development of structurally resilient architectures and nanostructures with embedded energy and/or comm. Focused develop of integrated sensor platform, suitable for multiple sensor components. Continue to develop and analyze nano-biomaterials for human performance sensing. Validate computation materials science techniques and models to characterize nanomaterials. Continue development and support of nano-bio manufacturing consortium. ***FY 2015 Plans:*** Validate and demonstrate biological engineering methods for sensors and electro-optic devices for complex hybrid materials. Continue to use pervasive computational materials science to model guided experiments and to enable rapid in-situ experimental data acquisition. Validate and demonstrate reliable materials and processes to optimize components for compact, lightweight, multi-functional devices for use in autonomy and human performance monitoring applications. Continue to develop materials and processes for writing and printing robust electronics on varied flexible & stretchable substrates, and the development of structurally resilient architectures and nanostructures with embedded energy and/or comm. Focused develop of integrated sensor platform, suitable for multiple sensor components. Initiate materials and process or strain resilient electronics. Continue to develop and analyze nano-biomaterials for human performance sensing. Continue to validate computation materials science techniques and models to characterize nanomaterials. Continue development and support of nano-bio manufacturing consortium.			
Accomplishments/Planned Programs Subtotals	25.976	30.302	28.693

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624348 / *Materials for Electronics, Optics, and Survivability*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602102F / *Materials*	Project (Number/Name) 624349 / *Materials Technology for Sustainment*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
624349: *Materials Technology for Sustainment*	-	24.256	26.163	42.211	-	42.211	43.992	46.911	52.052	51.936	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project develops materials and 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 2013	FY 2014	FY 2015
Title: Sensing Technologies	11.256	12.109	16.000
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 2013 Accomplishments: Advanced eddy current models and techniques to detect, characterize and track damage of components for aerospace systems. Assessed methods to enhance the sensing of damage in multi-layered structures and at complex geometries representative of aircraft structures and engine components. Advanced sensing methodologies to detect and begin to characterize the material microstructure that affects the structural integrity of aerospace systems. Developed and improved more affordable life cycle management approaches and life extension capability for aerospace structure and turbine engines. Investigated approaches to characterize material properties of specialty coatings.			
FY 2014 Plans: Continue to improve and validate modeling capabilities required to enable materials and damage characterization via nondestructive evaluation methods. Conduct and demonstrate enhanced sensing and characterization of damage in multi-layered structures to improve detectable limits and the probabilities of finding deeply imbedded or hidden damage in aerospace systems. Continue developing advanced sensing technologies to detect and characterize changes in material structure, material properties, damage, and other factors that detrimentally affect aerospace systems. Continue to develop innovative inspection technologies to			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624349 / *Materials Technology for Sustainment*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
enable rapid assessment of LO material performance. Continue research to assess metals performance in aerospace systems for more affordable life management practices and life extension for aerospace structures and turbine engines. ***FY 2015 Plans:*** Continue to improve and validate nondestructive evaluation modeling capabilities and use these competences to drive improvements in capability to detect and characterize damage in realistic aerospace structures and engine components. Begin to develop approaches to address the variability inherent in aerospace systems and materials and begin to quantify the impact of that variability on nondestructive inspection capability and reliability. Validate and demonstrate advanced sensing technologies to detect and characterize changes in material properties, damage evolution, and other factors that detrimentally affect aerospace systems. Initiate development and validation of damage state awareness approaches and methodologies for use on aerospace structures and engine components. Validate repeatability and functionality of innovative LO inspection methods to enable rapid assessment of LO material performance. Demonstrate assessment of enhanced metals performance in aerospace systems. Initiate development of advanced materials and processes to monitor and evaluate LO material state awareness.			
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 2013 Accomplishments:*** Evaluated advanced materials and processes technology to repair and extend the life of Air Force legacy systems. Investigated failure limits for emerging Air Force systems. Continue to validate and demonstrate test methods and techniques to understand effects of service environments, corrosion, residual stresses, and material processes on structural materials. Transitioned advanced materials technologies and designs for improved maintainability and life cycle cost of conductive outer-moldline films, coatings, access panel treatments, and multifunctional systems. ***FY 2014 Plans:*** Validate and demonstrate advanced materials and processes technology to repair and extend the life of 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, corrosion, residual stresses, and material processes on structural materials. 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. ***FY 2015 Plans:*** Continue to validate and demonstrate advanced materials and processes technology to repair and extend the life of Air Force legacy systems. Validate and demonstrate understanding of failure limits for emerging Air Force systems. Develop improved lifecycle prediction test methods and techniques to understand effects of service environments, corrosion, residual stresses, and	4.000	4.054	11.500

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624349 / *Materials Technology for Sustainment*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
material processes on structural and functional materials. Assess advanced materials, processes and designs for improved repair and maintainability and life cycle cost of outer-moldline coatings, access panel treatments, and multifunctional systems. Initiate LO affordability technologies and processes to reduce maintenance costs of LO materials.			
Title: Failure Analysis Technologies	9.000	10.000	14.711
Description: Develop support capabilities, information, and processes to resolve materials problems and provide electronic and structural failure analysis of components. ***FY 2013 Accomplishments:*** Performed quick response failure analyses and materials investigations. Provided advanced materials solutions to ensure critical warfighter system availability and safety of flight. Developed microelectromechanical system (MEMS) failure analysis capabilities. Validated advanced electrostatic discharge protection technologies and procedures for emerging avionics subsystems. Transitioned advanced test methods for analyzing electrical and structural failures of emerging materials. Validated test criteria and demonstrate advanced wiring materials technologies to replace aging wiring systems. Demonstrated new wiring technologies for emerging weapon systems. ***FY 2014 Plans:*** 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. Develop advanced functional materials and 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. Validate and demonstrate new wiring technologies for emerging weapon systems. Initiate research to provide advanced materials to improve systems sustainment in field and Air Force Program Offices. ***FY 2015 Plans:*** Continue to perform quick response failure analyses and materials investigations. Continue to investigate 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 functional materials and 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. Initiate development on new, more durable materials and protection for high power wiring technologies for Air Force weapon			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602102F / *Materials*	**Project (Number/Name)** 624349 / *Materials Technology for Sustainment*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
systems. Continue research to provide advanced materials to improve systems sustainment in field and Air Force Program Offices.			
Accomplishments/Planned Programs Subtotals	24.256	26.163	42.211

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	108.536	119.624	105.747	-	105.747	121.690	125.883	127.449	134.605	Continuing	Continuing
622401: *Structures*	-	37.783	44.046	32.779	-	32.779	52.947	51.429	51.890	56.166	Continuing	Continuing
622403: *Flight Controls and Pilot-Vehicle Interface*	-	32.540	35.222	29.499	-	29.499	28.281	29.173	30.404	30.982	Continuing	Continuing
622404: *Aeromechanics and Integration*	-	38.213	40.356	27.306	-	27.306	25.263	29.140	28.507	29.104	Continuing	Continuing
622405: *High Speed Systems Technology*	-	-	-	16.163	-	16.163	15.199	16.141	16.648	18.353	Continuing	Continuing

The FY 2015 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 aerodynamics for legacy and future aerospace vehicles. 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 vehicles, sustained high speed, 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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	120.719	119.672	121.849	-	121.849
Current President's Budget	108.536	119.624	105.747	-	105.747
Total Adjustments	-12.183	-0.048	-16.102	-	-16.102
• Congressional General Reductions	-0.215	-0.048			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.030	-			
• Other Adjustments	-9.938	-	-16.102	-	-16.102

Change Summary Explanation

FY13 decrease due to Sequestration.

FY15 decrease due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622401 / *Structures*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622401: *Structures*	-	37.783	44.046	32.779	-	32.779	52.947	51.429	51.890	56.166	Continuing	Continuing

The FY 2015 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 subsystem hardware items and adaptive mechanisms into the aerospace structures and/or skin of the platform.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Aircraft Service Life Technologies	22.031	28.427	24.828
Description: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring technologies. ***FY 2013 Accomplishments:*** Continued development of engineered residual stress concepts, analysis, and applications. Continued the development concepts for risk informed decision-making. Continued efforts for condition-based maintenance of structural integrity. Continued the development of failure criteria tools for advanced aircraft components and concepts. Initiated efforts in certification of advanced composite for aircraft structures. Completed the development of integrated sensors for determination of system health. ***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 composite and metallic components. Continue efforts in certification of advanced composite for aircraft structures. Develop an integrated system of data, models, and analysis tools that enable better decisions regarding fleet lifecycle management and sustainment. ***FY 2015 Plans:*** Complete the technology development concepts for risk informed decision-making. Complete technology efforts for condition-based maintenance of structural integrity. Continue the technology development of failure criteria tools for advanced aircraft composite and metallic components. Continue efforts in certification of advanced composite for aircraft structures. Continue development of an integrated system of data, models, and analysis tools that enable better decisions regarding fleet lifecycle management and sustainment.			
Title: Vehicle Design Technologies	2.765	2.600	3.785
Description: Title changed from: Airworthiness Certification Technologies to Vehicle Design Technologies.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622401 / *Structures*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Develop methodologies to reduce the cost and time involved from design to full-scale testing of structural concepts and aircraft systems. ***FY 2013 Accomplishments:*** Continued development of multi-disciplinary methodologies that will allow for lower cost analytical certification of advanced composite structures. Completed experimental validation of integrated system health management technologies for aircraft subsystems. Continued the development of advanced aircraft flutter analysis tools. ***FY 2014 Plans:*** Continue development of multi-disciplinary methodologies that will allow for lower cost advanced structures. Continue the development of advanced high fidelity aircraft design analysis tools. Develop high fidelity multidisciplinary design methods to enable efficient supersonic air vehicle technologies. ***FY 2015 Plans:*** Complete development of multi-disciplinary methodologies that will allow for lower cost advanced structures. Continue the development of advanced high fidelity aircraft design analysis tools. Continue development high fidelity multidisciplinary design methods to enable efficient supersonic air vehicle technologies.			
Title: Structural Concepts ***Description:*** Thrust title changed from Survivability and Performance Technologies Develop to Structural Concepts. Develop design methods, processes, and lightweight, adaptive, and multifunctional structural concepts to capitalize on new materials, multi-role considerations, and technology integration into aircraft systems. ***FY 2013 Accomplishments:*** Continued the development of low-cost technologies to increase the survivability and performance of future aircraft systems. ***FY 2014 Plans:*** Continue the development of low-cost technologies to increase the survivability and performance of future systems. Develop efforts on energy efficient integration of conformal load bearing antenna technologies. ***FY 2015 Plans:*** Continue efforts on energy efficient integration of conformal load bearing antenna structural concepts. Develop lightweight, adaptive, and efficient structural concepts for future mobility and future air dominance.	2.127	2.779	4.166
Title: Extreme Flight Environment Technologies	10.860	10.240	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622401 / *Structures*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Further developed technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Continued to develop structural concepts and analysis methods for design and evaluation of hot primary structures. Completed the refinement of affordable space access concepts and applied 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. ***FY 2015 Plans:*** This work moves to Program 0602201, Project 622405 - High Speed Systems Technology.			
Accomplishments/Planned Programs Subtotals	37.783	44.046	32.779

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622403 / *Flight Controls and Pilot-Vehicle Interface*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622403: *Flight Controls and Pilot-Vehicle Interface*	-	32.540	35.222	29.499	-	29.499	28.281	29.173	30.404	30.982	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Advanced Flight Controls Technologies	14.660	14.886	10.846
Description: Develop technologies for advanced control-enabled capabilities, including flight controls, components, and integrated vehicle monitoring systems for both manned and remotely piloted aircraft. ***FY 2013 Accomplishments:*** Continued the development, assessment, and certification capability of advanced flight control mechanization technologies for highly reliable operations under adverse environments. Continued development of control configurations for small remotely piloted aerospace systems. Continued development of control systems hardening and health assessment technologies for enhanced survivability. ***FY 2014 Plans:*** Continue 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. Complete the assessment of adaptive guidance and control technologies for fault/damage tolerance in unmanned space access systems. ***FY 2015 Plans:*** Continue the development, demonstration, and assessment of advanced flight control mechanization technologies for trusted and certifiable operations under adverse and contested environments. Continue the development of survivable and health-adaptive control system architecture; developing new methods and expanding to include more aircraft systems.			
Title: Manned and Unmanned Teaming Technologies	11.064	14.015	13.297

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622403 / *Flight Controls and Pilot-Vehicle Interface*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop technology for flight control systems that will permit safe interoperability between manned and remotely piloted aircraft. ***FY 2013 Accomplishments:*** Continued the development and assessment of advanced control automation techniques. Continued 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. Continued the development and assessment of adaptive guidance and control technologies for fault/damage tolerance. ***FY 2014 Plans:*** Continue 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. Develop and assess manned-unmanned aircraft teams in tactical environments ***FY 2015 Plans:*** Continue development, demonstration, and assessment of advanced control automation techniques. Continue the development of mixed initiative control techniques for teams of remotely piloted aircraft and/or manned-unmanned teams in dynamic mission environments, as well as for the integration of unmanned systems into controlled airspace and airbase operations. Complete study of airbase infrastructure options and implications, and initiate systems prototype development.			
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 2013 Accomplishments:*** Continued 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. Continued technology analyses of unmanned air systems in manned/ unmanned airspace and airbase operations. Refined trade studies of vehicle concepts for strike, mobility and reconnaissance. ***FY 2014 Plans:*** Continue modeling and simulation efforts to evaluate emerging autonomous and robust flight control technologies and concepts, as well as assess mission-level performance of integrated aerospace systems. Continue analyses of automated unmanned air	6.816	6.321	5.356

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622403 / *Flight Controls and Pilot-Vehicle Interface*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Continue modeling and simulation efforts to evaluate emerging autonomous and robust flight control technologies and concepts, as well as assess mission-level performance of integrated aerospace systems. Continue analyses of automated unmanned air systems and manned-unmanned teams 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	32.540	35.222	29.499

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622404 / *Aeromechanics and Integration*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622404: *Aeromechanics and Integration*	-	38.213	40.356	27.306	-	27.306	25.263	29.140	28.507	29.104	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Aerodynamic Systems Technologies	9.484	8.643	10.245
Description: Name change from Aeronautical Technologies for Unmanned Aircraft to Aerodynamic Systems Technologies. Develop aerodynamic assessment prediction methods centered on expanding the design capabilities of future air vehicles. ***FY 2013 Accomplishments:*** Continued to develop and assess aeronautical technologies that enable broad use of unmanned aircraft. Continued 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. Continued 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. ***FY 2015 Plans:*** Continue to develop and assess aerodynamic technologies that enable future revolutionary manned and unmanned air vehicles. Continue to develop and assess advanced aircraft configurations for Mobility and Air Dominance. Complete technology assessments on next generation Air Dominance vehicle concepts. Initiate technology assessments on next generation tanker and transport systems.			
Title: Concepts, Designs, and Analysis of High Speed Technologies	6.811	8.583	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622404 / *Aeromechanics and Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Continued to develop technologies to enable high-speed flight. Continued 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. ***FY 2015 Plans:*** This work will move to Project 622405 - High Speed Systems Technology.			
Title: Next Generation Aerodynamic Technologies ***Description:*** Thrust title changed from Next Generation Multi-Role Large Aircraft Technologies to Next Generation Aerodynamic Technologies for clarity. Effort and focused remained the same, to develop and assess technologies for the next generation of multi-role large aircraft. ***FY 2013 Accomplishments:*** Continued to develop aerodynamic and propulsion integration technologies that enable multiple roles and missions for delivery and support aircraft. Conducted 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 high fidelity aerodynamic analysis and method development. Continue development of practical laminar flow technologies to highly swept wings and higher Reynolds numbers. Begin studies and analysis to investigating more extensive legacy fleet fuel savings opportunities for drag reduction and formation flight. ***FY 2015 Plans:***	21.918	23.130	9.929

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622404 / *Aeromechanics and Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue high fidelity aerodynamic analysis and method development. Continue development of practical laminar flow technologies to highly swept wings and higher Reynolds numbers. Continue studies and analysis to investigating more extensive legacy fleet fuel savings opportunities for drag reduction and formation flight			
Title: Aircraft Integration Technologies ***Description:*** This is a new major thrust. Develop enabling technologies to allow efficient and effective integration of propulsion, weapons, and subsystems into current and future air vehicles. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** Develop aerodynamic and propulsion integration technologies that enable future mobility and fighter aircraft. Develop analyses and experiments to investigate propulsion integration flow control to enhance vehicle performance. Development of innovative aerodynamic control methods for integrating high bypass propulsion for future mobility aircraft. Development of propulsion integration system for a next generation high bypass ration engine. Development of advanced weapons integration concepts for next generation Air Dominance.	-	-	7.132
Accomplishments/Planned Programs Subtotals	38.213	40.356	27.306

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622405 / *High Speed Systems Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622405: *High Speed Systems Technology*	-	-	-	16.163	-	16.163	15.199	16.141	16.648	18.353	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

Note

This is a new Project, starting in FY15.

A. Mission Description and Budget Item Justification

This program investigates, analyzes and develops high speed/hypersonic aerospace vehicle technologies. Advanced high temperature structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analyses. Advanced flight control technologies are developed and simulated for hypersonic vehicles. These technologies will enable future high speed weapons; intelligence, surveillance and reconnaissance systems; and space access vehicles

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: High Speed Systems Technology	-	-	6.231
Description: Develop high temperature structural analysis methods and technologies for extreme operating conditions in current and future air vehicles. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** Initiate development of innovative structural concepts for high speed/hypersonic air vehicles. Initiate development of analytical methods for predicting structural response needed for design and evaluation of hot primary structure for hypersonic vehicles. Initiate the impact of path dependent structural behavior on the service life prediction for hot structures encountering extreme environments. Initiate the development and integrate model uncertainty methods into multi-disciplinary simulations and quantify its impact on the structural margin. Initiate development of structural analysis methods and technology for hot structure concepts under extreme environment loading conditions. Initiate the assessment of the aerospace community to quantify the structural margins for extreme environment hot structure through experimental validation of ground test articles.			
Title: High Speed Vehicle Aeromechanics and Integration	-	-	9.932

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622405 / *High Speed Systems Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop new and improved components, concepts, and designs for sustained flight of high-speed/hypersonic expendable and re-useable vehicles. Conduct analyses of high speed/hypersonic vehicles to enable revolutionary capabilities. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** Mature critical technologies for high speed/hypersonic flight. Begin development of design/analysis techniques/tools and experimental approaches to enable enhanced high-speed air induction system starting, operability, and performance for propulsion integration concepts over a wide range of flight conditions. Begin development of high speed system concepts that provide revolutionary capabilities. Investigate aeromechanic technologies to reduced drag and enable robust stability & control at low dynamic pressure flight conditions. Initiate efforts to characterize high-speed phenomena and develop and validate fundamental high-speed technologies through experimental testing. As part of international collaborative effort, conduct flight tests of Mach 6 adaptive guidance and control flight experiment and Mach 8 ethylene powered sustained cruise flight experiment. Develop design of multi-functional terminal sensor integrated flight experiment. Complete refined, mission-level modeling and simulation of preferred high speed weapon alternatives. Assess mission-level effectiveness and refine definition of preferred high speed weapon alternatives. Develop campaign-level modeling and simulation of high speed weapon alternatives. Assess campaign-level benefits of preferred high speed weapon alternatives			
Accomplishments/Planned Programs Subtotals	-	-	16.163

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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	80.616	104.427	81.957	-	81.957	97.212	108.693	110.599	113.343	Continuing	Continuing
621123: *Learning and Operational Readiness*	0.000	11.385	14.466	16.613	-	16.613	19.928	23.697	23.027	20.907	Continuing	Continuing
625328: *Human Dynamics Evaluation*	0.000	22.076	23.290	17.151	-	17.151	22.843	25.059	25.054	25.523	Continuing	Continuing
625329: *Sensory Evaluation and Decision Science*	0.000	28.104	38.847	27.912	-	27.912	28.301	30.261	30.409	31.501	Continuing	Continuing
627757: *Bioeffects*	0.000	19.051	27.824	20.281	-	20.281	26.140	29.676	32.109	35.412	Continuing	Continuing

The FY 2015 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, 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 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 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	89.319	89.483	94.584	-	94.584
Current President's Budget	80.616	104.427	81.957	-	81.957
Total Adjustments	-8.703	14.944	-12.627	-	-12.627
• Congressional General Reductions	-0.190	-0.056			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	15.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.165	-			
• Other Adjustments	-7.348	-	-12.627	-	-12.627

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Project: 625329: *Sensory Evaluation and Decision Science*		
Congressional Add: *Program Increase*	-	10.000
Congressional Add Subtotals for Project: 625329	-	10.000
Project: 627757: *Bioeffects*		
Congressional Add: *Program Increase*	-	5.000
Congressional Add Subtotals for Project: 627757	-	5.000
Congressional Add Totals for all Projects	-	15.000

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY 2015 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 621123 / *Learning and Operational Readiness*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
621123: *Learning and Operational Readiness*	-	11.385	14.466	16.613	-	16.613	19.928	23.697	23.027	20.907	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Continuous Learning	8.290	10.305	16.613

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 2013 Accomplishments:

Developed methods to capture, tag, and store mission performance data across LVC contexts using tactical fast jet as an exemplar. Evaluated technologies to assess and track the credibility of virtual and constructive players to augment live operational training and rehearsal. Began developing common scenarios and learning events for DMO systems integration. Created and validated initial scenarios for cyber team training in a Red Flag exercise environment. Completed the integrated combat operations planning trainer to improve C2 and ISR teaming. Initiated work to evaluate alternatives for common after action review and analysis tools for C2, ISR, and cyber team training. Initiated requirements definition and metrics development to support realistic LVC training for Anti Access/Area Denial (A2/AD) environments.

FY 2014 Plans:

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.

FY 2015 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 621123 / *Learning and Operational Readiness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Complete development of an analyst readiness research testbed for ISR and cyber operators. Extend learning assessment and management tools to support undergraduate pilot training. Evaluate different methods for secure, credible LVC training and rehearsal for fourth and fifth generation fighters. Create and document standards for tactical LVC training and readiness. Validate methods to quickly generate rule sets for security applications in C2 and ISR domains. Develop methods to generate realistic representations of adversary tactics for LVC training. Evaluate methods to rapidly reconfigure training environments for different scenarios and mission sets. Initiate work to develop agents to manage training activities in LVC. Begin requirements definition for LVC training applications to support enhancing warfighting in contested environments.			
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 2013 Accomplishments:*** Identified and validated mechanisms for fatigue and visual monitoring to support human performance augmentation. Completed integration of synthetic teammate for training research in RPA simulator. Created and verified technologies to develop models at a higher level of abstraction, enabling more accurate models of human cognition in complex, dynamic environments. Initiated research to identify potential application of models of learning and retention to complex, time-critical Air Force knowledge and skills. ***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. ***FY 2015 Plans:*** Effort is moved to Continuous Learning thrust to be consistent with future integration into LVC contexts.	3.095	4.161	-
Accomplishments/Planned Programs Subtotals	11.385	14.466	16.613

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 621123 / *Learning and Operational Readiness*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 625328 / *Human Dynamics Evaluation*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625328: *Human Dynamics Evaluation*	-	22.076	23.290	17.151	-	17.151	22.843	25.059	25.054	25.523	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

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 Measurement and Signature Intelligence (MASINT).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Human Analyst Augmentation	3.250	5.670	7.751
Description: Conduct research to enhance human components of ISR. Develop ability to improve human analytic efficiency and effectiveness with fewer personnel and in increasingly complex mission space. Develop the ability to improve human cognitive performance of the ISR weapon system through improved data exploitation and intelligence content synthesis. ***FY 2013 Accomplishments:*** Developed new multi-intelligence analysis concepts and prototypes based upon analyst evaluations. Conducted 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. ***FY 2015 Plans:*** Research and develop human centric approaches to enhance ISR analysts' ability to attend to relevant intelligence data when coupled with autonomous systems and agents.			
Title: Human Trust and Interaction	9.320	9.300	4.780

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625328 / *Human Dynamics Evaluation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: 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. Conduct research to address important aspects of trust in human-machine teams including investigating how a human knows an autonomous or semi-autonomous system is safe to use and should the system, data, conclusions, and decision recommendations be trusted. ***FY 2013 Accomplishments:*** Explored multicultural potential avenues of influence and develop adversary effects models and simulations. Developed tools, algorithms, and techniques for rapid development of speech recognition, machine translation, and natural language processing components in new languages and domains. Developed 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. Explored methods and developed 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. ***FY 2015 Plans:*** Develop guidelines for calibrated trust for symbiotic human-machine teaming. Develop work aids that enable analysts to think more deeply and methodically about their problem space by accounting for contextual factors including culture, religion, governance, and economy.			
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 2013 Accomplishments:*** Developed architectures for machine-intelligent biofidelic human threat models. Developed 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. Developed nano-bio technologies and sensor components to detect target molecules of interest in the	9.506	8.320	4.620

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625328 / *Human Dynamics Evaluation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
operational environment. Developed analysis tools to identify and track molecular-based threat signatures. Characterized and exploited 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. ***FY 2015 Plans:*** Develop algorithms capable of reliably detecting and characterizing human signatures by leveraging multiple sensing modalities, from multiple platforms, for human threat situation awareness. Develop sensors for novel molecular signatures for increased threat detection in an operational environment and human performance assessment.			
Accomplishments/Planned Programs Subtotals	22.076	23.290	17.151

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 625329 / *Sensory Evaluation and Decision Science*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625329: *Sensory Evaluation and Decision Science*	-	28.104	38.847	27.912	-	27.912	28.301	30.261	30.409	31.501	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Applied Neuroscience	8.672	10.127	12.000
Description: Develop technologies to enhance human performance, human-human and human-machine collaboration, and system interaction in distributed decision-making environments. Conduct research to predict physiological impacts of high-stress/ extreme environments.			
FY 2013 Accomplishments: Explored the development of trust metrics that can be used to design and enable trust automation for operators. Developed the framework for modeling physiological and behavioral workload on the human operator. Developed adaptive algorithms for workload management and mitigation. Evaluated utility of workload assessment tool for teams. Investigated potential tools for enhancing warfighter cognitive resiliency and performance through the manipulation of intrinsic biological and physiological mechanisms and processes. Defined metrics and biomarkers of resiliency and performance that can be integrated into these tools for sensing and assessing cognitive state. Developed 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.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Investigate individual and team state sensing and assessment algorithms and methods to examine augmentation mitigation strategies leading to improved warfighter performance. Develop team workload and trust models for autonomy, increased human performance monitoring, and performance improvement. Identify stress-driven metrics and processes that influence human performance. Define neurophysiological, psychological, and genetic mechanisms and processes for developing guidelines to enhance warfighter cognitive resiliency and performance. Apply physiology computational modeling methods to predict high-stress/extreme environmental effects on the human. Develop augmentation techniques for improving performance in operational environments that include human-machine teaming. Investigate interface technologies and exposure design criteria to protect operators and mitigate injury and performance risks in current and future weapon systems. Develop contamination sensor technology for on-board oxygen generation systems for hypoxia vulnerability risk mitigation. Investigate new technologies for aircraft next generation on-board oxygen generation system.			
Title: Human Role in Semiautonomous Systems	6.035	6.266	5.580
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 2013 Accomplishments:*** Identified human operator-RPA automation interaction technologies and techniques that will provide increased situational awareness while exercising supervisory control of multiple RPAs. Investigated and developed course-of-action tools, displays, and system software architectures that will support an operator's choice between several courses of action. Explored the use of adaptive automation for teams of RPAs/RPA operators to enable real-time situational awareness of human and vehicle states. Developed 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:*** 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			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
decision-making. Begin developing adjustable, adaptive levels of automation to support flexible control of unmanned systems depending on mission and environmental context. ***FY 2015 Plans:*** Demonstrate and quantify the use of selected automation technologies and various tools to enable choices between courses of action for the command and control of multiple RPAs. Integrate advanced visualization concepts and interaction methods for managing information from on- and off-board sources to support RPA operator decision-making into high-fidelity simulations for test and evaluation. Perform advanced simulation of 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 2013 Accomplishments:*** Assessed human perception and performance of fused, multisource information. Developed visualizations using visual analytics for representing information from large, disparate data sets. Extended visualization techniques to three-dimensional (3-D) displays. Assessed 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. ***FY 2015 Plans:*** Evaluate image enhancement and fusion techniques for improving human perception and performance. Assess visual analytics techniques for visualizing large, disparate data sets. Investigate cyber operations visualization techniques for transforming numerical data into actionable information. Explore decision aids for multisource fusion methods.	7.522	8.152	6.660
Title: Battlespace Acoustics ***Description:*** Conducts research on advanced auditory and communication technologies that mitigate effects of noise and enhance performance in operational environments. ***FY 2013 Accomplishments:***	5.875	4.302	3.672

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 625329 / *Sensory Evaluation and Decision Science*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Explored the use of advanced multimodal interfaces to aid combat search and rescue teams in simulated scenarios. Assessed 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 decision making. ***FY 2015 Plans:*** Validate auditory interfaces that enable the human operator to respond to cyber-attacks through persistent auditory displays. Optimize the use of multimodal displays and visualizations to communicate time critical information to distributed teams. Validate the combined effectiveness of audio displays and multimodal interaction techniques to support human decision-making.			
Accomplishments/Planned Programs Subtotals	28.104	28.847	27.912

	FY 2013	FY 2014
Congressional Add: Program Increase	-	10.000
FY 2013 Accomplishments: N/A		
FY 2014 Plans: Conduct Congressionally-directed Effort.		
Congressional Adds Subtotals	-	10.000

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602202F / *Human Effectiveness Applied Research*	Project (Number/Name) 627757 / *Bioeffects*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
627757: *Bioeffects*	-	19.051	27.824	20.281	-	20.281	26.140	29.676	32.109	35.412	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Optical Radiation Bioeffects	7.442	6.417	4.997
Description: Conduct laboratory experiments and field research on laser bioeffects, enabling military exploitation of laser technology while providing countermeasures for optical hazards/threats.			
FY 2013 Accomplishments: Developed high-power probabilistic range safety tools for prediction eye and skin hazard zones from high energy laser weapon systems and concepts. Developed models and methods for approaches using optical radiation for future weapon systems with scalable, disruptive, and ultra-precise effects. Developed parameters for optimizing laser vision effect models for advanced laser eye protection technologies and non-lethal weapon engagement-level assessments.			
FY 2014 Plans: 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.			
FY 2015 Plans: Integrate components of engagement-level simulations for laser bioeffects into broader DoD modeling and simulation products for the purpose of mission-level and campaign level models. Initiate studies to evaluate bioeffects, protection needs, and collateral			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 627757 / *Bioeffects*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
effects of emerging directed energy systems concepts. Complete data collection for currently identified optical radiation damage and transient vision effects for use in next-generation of standardized personnel vulnerability models.			
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 2013 Accomplishments:*** Integrated basic mechanisms of interactions between biology and RFR for validation of bioeffects models from ultra-short, high-peak power, RF systems. Investigated terahertz (THz) radiation effects on cells and tissues and improve bioeffects models for exposure. Initiated proposals for refined exposure standards for THz radiation. Assessed 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. ***FY 2015 Plans:*** Conduct empirical laboratory tests on the human behavioral response to combined effects of directed energy sources. Investigate high peak power human performance effects. Explore whole-body biological effects of directly applied ultra-short pulses. Determine effects of RF overexposure on neurological tissue.	7.127	8.292	4.952
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 2013 Accomplishments:*** Conducted toxicology review, completed cockpit chemicals assessment, and provided analysis to support aircraft/pilot fit-to-fly for grounded system. Advanced namomaterial bioexposure analysis with novel science; designed system to capture and material to bioanalyze real-time emissions of flight-line nanoparticulate exposure. Determined toxicity of two novel biofuels and fuel component performance mixture for use in Air Force weapon systems. Determined molecular markers associated with	4.482	8.115	10.332

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 627757 / *Bioeffects*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
fatigue resistance from enhanced protein diets in high-level performers. Advanced knowledge of protein components as important macronutrients known to impact human physiology performance and cognition. ***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. ***FY 2015 Plans:*** Advance toxicity and nanotoxicity research; investigate/establish toxicity impacts to selected organ systems in 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 human performance using in vitro and in vivo models and modeling and support human studies of the same. 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 real-time sensing of pilot and hazard protection of ground crews. Conduct research to understand novel mechanisms of fundamental interaction of nanomaterials in a biological system.			
Accomplishments/Planned Programs Subtotals	19.051	22.824	20.281

	FY 2013	FY 2014
Congressional Add: Program Increase ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** Conduct Congressionally-directed Effort.	-	5.000
Congressional Adds Subtotals	-	5.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602202F / *Human Effectiveness Applied Research*	**Project (Number/Name)** 627757 / *Bioeffects*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air 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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	209.315	197.546	172.550	-	172.550	185.363	182.248	188.999	188.596	Continuing	Continuing
623012: *Advanced Propulsion Technology*	-	21.275	22.304	17.646	-	17.646	20.415	23.074	23.643	24.301	Continuing	Continuing
623048: *Combustion and Mechanical Systems*	-	14.290	13.235	12.008	-	12.008	12.123	12.278	12.507	12.748	Continuing	Continuing
623066: *Turbine Engine Technology*	-	91.999	77.444	57.245	-	57.245	63.292	50.298	53.808	54.416	Continuing	Continuing
623145: *Aerospace Power Technology*	-	27.054	26.587	29.393	-	29.393	31.139	32.404	32.549	31.530	Continuing	Continuing
624847: *Rocket Propulsion Technology*	-	49.753	52.651	51.287	-	51.287	53.372	59.068	61.266	60.276	Continuing	Continuing
625330: *Aerospace Fuel Technology*	-	4.944	5.325	4.971	-	4.971	5.022	5.126	5.226	5.325	Continuing	Continuing

The FY 2015 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 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	232.547	197.546	173.232	-	173.232
Current President's Budget	209.315	197.546	172.550	-	172.550
Total Adjustments	-23.232	-	-0.682	-	-0.682
• Congressional General Reductions	-0.394	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.640	-			
• Other Adjustments	-19.198	-	-0.682	-	-0.682

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*	Project (Number/Name) 623012 / *Advanced Propulsion Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
623012: *Advanced Propulsion Technology*	-	21.275	22.304	17.646	-	17.646	20.415	23.074	23.643	24.301	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Demonstrate Low Mach Scramjet Technologies	1.650	-	-
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 2013 Accomplishments:*** Completed development and demonstration of advanced engine control systems and flight weight scramjet engine components. Built 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. Conducted direct connect testing of flight weight scramjet components for cold start systems. ***FY 2014 Plans:*** Advance scramjet engine controls and cold start demonstration development activities transition to Program 0603216F Aerospace Propulsion, project 635098 Advanced Aerospace Propulsion. ***FY 2015 Plans:*** N/A			
Title: Integrated Propulsion Technologies	0.120	-	-
Description: Conduct assessments, technology design trades, and simulations to integrate combined cycle engines (CCEs) and air breathing hypersonic propulsion technologies into future systems. ***FY 2013 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623012 / *Advanced Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Complete engine performance objectives and road mapping to enable development of affordable hypersonic flight demonstrators jointly with NASA and DARPA. ***FY 2014 Plans:*** Effort transfered to Hypersonic Scramjet Technologies thrust in the same project, where component technologies will be integrated into scramjet engine subsystems for hypersonic systems. ***FY 2015 Plans:*** N/A			
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 2013 Accomplishments:*** Continued to develop advanced engine components to improve scramjet operating margin and to refine scramjet scaling laws for reusable applications. Continued to develop techniques to decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs. Continued to develop low internal drag flame stabilization devices and flight test engine components. Completed critical designs and initiate fabrication of scramjet combustors in medium scale (ten times) scramjet engines. Prepared 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 the minimum scramjet ignition from Mach 4.5 to Mach 3.5 to provide robust options for Combined Cycle Engines (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. ***FY 2015 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. Completed critical designs and initiate fabrication of scramjet combustors in medium scale (ten times) scramjet engines. Complete fabrication of heavyweight direct connect scramjet combustors. Initiate direct connect testing of medium scale (ten times) scramjet combustors from Mach 3.5 to Mach 7	19.505	22.304	17.646
Accomplishments/Planned Programs Subtotals	21.275	22.304	17.646

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623012 / *Advanced Propulsion Technology*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*	Project (Number/Name) 623048 / *Combustion and Mechanical Systems*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
623048: *Combustion and Mechanical Systems*	-	14.290	13.235	12.008	-	12.008	12.123	12.278	12.507	12.748	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Combustion Technologies	5.583	5.116	4.658
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 2013 Accomplishments: Developed new models for combustion processes at high pressure conditions. Tested combustion system designs that produced low pollutant emissions. Tested rotational detonation engine (RDE) concepts coupled with conventional turbomachinery. Evaluated alternative fuels and their impact on engine performance and durability. Tested novel compact combustion systems at relevant operating conditions.			
FY 2014 Plans: Design and test full-annular ultra compact combustors. Evaluate augmentor technologies for screech reduction. Fabricate and test reference combustors for alternative fuels. Implement new technologies to operate small-scale propulsion systems with reduced octane fuels. Continue to develop new rotational detonation engine (RDE) concepts.			
FY 2015 Plans: Begin to develop combustor, augmentor and constant volume combustion or pressure gain combustion technologies such as pulse detonation engines (PDEs) or rotational detonation engines (RDEs) to enable the next generation of gas turbine engines,			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623048 / *Combustion and Mechanical Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
new engine cycles, and combined-cycles. Explore the interactions and effects of compressor and turbine components on the combustor and combustor materials, to reduce engine weight and increase efficiency. Continue using advanced diagnostics to obtain high-quality datasets that can be made available to and used by academia and industry for model development. Maintain efforts to determine necessary reference performance and operability combustion systems and metrics to decrease the cost of certifying new and alternative fuels in weapon systems.			
Title: Diagnostic Technologies ***Description:*** Develop and demonstrate optical, electromechanical, and laser diagnostic tools and sensors for application to revolutionary propulsion technologies. ***FY 2013 Accomplishments:*** Applied advanced laser diagnostics and novel optics configurations to high pressure test cell environment. Demonstrated particle image velocimetry in high pressure combustion test apparatus. Investigated 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. ***FY 2015 Plans:*** Develop and demonstrate diagnostic systems for high-bandwidth (kHZ-MHz) measurements of combustion chemistry and physics based on 1) time-division-multiplexed hyperspectral absorption spectroscopy, 2) pulse-burst lasers, and 3) ultrashort-pulse (picosecond, femtosecond) lasers. Apply to laboratory flame test rigs, engine test cells, and fielded systems.	1.015	0.991	0.927
Title: Lubricant Technologies ***Description:*** Develop, test, and qualify advanced turbine engine lubricants. Generate and maintain military specifications for aviation engine lubricants. ***FY 2013 Accomplishments:*** Demonstrated lube system health management control algorithms with full-scale technology readiness level 5 test rig hardware. Tested enhanced ester oils in demonstrator turbine engines. Continued investigating advanced lube system thermal management technologies for fuel efficient turbine engines. Developed new oil traction models and validated them with experimental data. ***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	3.764	3.490	3.123

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623048 / *Combustion and Mechanical Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
investigating advanced lube system thermal management technologies for fuel efficient engines. Incorporate new traction models into bearing heat generation models. ***FY 2015 Plans:*** Execute plan for transitioning Enhanced Ester (EE) oils into the fleet. Demonstrate EE oils on Adaptive Engine Technology Demonstrator (AETD) engine cores. Develop transition plans for mechanical system health monitoring system technologies. Continue investigating advanced lube system thermal management technologies for fuel efficient and hi-mach engine applications.			
Title: Bearing Technologies ***Description:*** Develop and test advanced bearing material technology and bearing concepts for small, intermediate, and large-sized turbine engine applications. ***FY 2013 Accomplishments:*** Conducted parametric active thrust control experiments to validate load control algorithms. Conducted seeded fault bearing tests to validate reliable active and autonomous thrust load control. Continue to integrate active thrust control, vibration, and oil debris sensing for complete technology readiness level (TRL) 6 five 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. ***FY 2015 Plans:*** Continue full-scale bearing rig testing in support of adaptive, fuel efficient engines. Continue oil-free, foil bearing R&D in support of supersonic expendable engines and remotely piloted aircraft. Continue developing improved bearing material life model. Continue maturing active bearing thrust control system and fuse with engine prognostics health monitoring system for future fuel efficient engines.	3.928	3.638	3.300
Accomplishments/Planned Programs Subtotals	14.290	13.235	12.008

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*	Project (Number/Name) 623066 / *Turbine Engine Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
623066: *Turbine Engine Technology*	-	91.999	77.444	57.245	-	57.245	63.292	50.298	53.808	54.416	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Turbofan/Turbojet Engine Core Technologies	36.578	35.062	27.905
Description: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports.			
FY 2013 Accomplishments: Continued to develop modeling and simulation tools for advanced components including coupled aerothermal models and turbine durability design. Continued to conduct bench and rig test using surface mapping thin film temperature gauges. Developed high resolution non-contact stress measurement systems for high frequency response measurement. Demonstrate improvements from active clearance and flow control. Conducted rig testing of high-power low-emission combustion. Developed improved compressor aerodynamic design tools to extend engine operability and increase 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 incresae efficiency. Initiate conceptual design of efficient, very high pressure ratio core component technologies. Complete Adaptive Versatile Engine Technology (ADVENT)effort.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623066 / *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. Complete conceptual design, and initiate detailed design of efficient, very high pressure ratio core component technologies.			
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 2013 Accomplishments:*** Developed modeling and simulation tools including methods to predict behavior of serpentine inlets and nozzles. Demonstrated 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. ***FY 2015 Plans:*** Initiate adaptive engine conceptual designs to reduce specific fuel consumption reduction by up to 35% for embedded high bypass turbofans, and for sustained supersonic strike applications. Continue to develop modeling and simulation tools including methods to predict behavior of serpentine inlets and nozzles. Conduct bench and rig tests to validate modeling and simulation tools to predict fan/inlet interaction for both podded and embedded propulsion systems. Conduct bench and rig tests to validate probabilistic ignition prediction tool for advanced augmentor design. Develop models to validate function and durability of high temperature electronics for engine control.	8.672	8.177	23.615
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. ***FY 2013 Accomplishments:*** Developed and applied advanced modeling and simulation tools for variable cycle component design, advanced cooling concepts, compact augmentors, and composite structures. Demonstrated advanced designs in rig testing. ***FY 2014 Plans:***	3.993	3.900	4.541

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623066 / *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 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. Utilize validation data to develop improved 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 2013 Accomplishments:*** Developed and applied advanced modeling and simulation tools for advanced cooling concepts, high efficiency gearboxes, and high performance airfoils. Developed 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. ***FY 2015 Plans:*** Continue to refine and 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.	1.545	1.626	1.184
Title: Adaptive Turbine Engine Technologies ***Description:*** Develop high performance, durable components which enable adaptive turbine engine technologies. ***FY 2013 Accomplishments:*** Completed 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. Initiated preliminary designs addressing extensive performance, operability, maintainability, and prognostic health management requirements. Designed and conducted 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,	41.211	28.679	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623066 / *Turbine Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
controls and accessories, thermal management subsystems, and three-stream compatible afterburner/exhaust systems. Conducted ground rig testing of at least two unique adaptive fan concepts. Completed 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. This completes this effort. ***FY 2015 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	91.999	77.444	57.245

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*	Project (Number/Name) 623145 / *Aerospace Power Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
623145: *Aerospace Power Technology*	-	27.054	26.587	29.393	-	29.393	31.139	32.404	32.549	31.530	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: High Power System Technologies	26.798	26.587	29.393
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 2013 Accomplishments:*** Completed critical design review of Integrated Vehicle Energy Technology (INVENT) effort to develop adaptive power and thermal management subsystems for next generation military air platforms. Initiated 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. ***FY 2015 Plans:*** Initiate integrated ground demonstration of adaptive power and thermal management system for next generation air platforms. Continue testing of subsystems hardware in conjunction with continued platform level tip-to-tail modeling and simulation energy optimization. Initiate development of advanced, safe energy storage and management systems to include Silicon Carbide applications and batteries.			
Title: Special Purpose Application Technologies	0.256	-	-
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 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 623145 / *Aerospace Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: 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 was completed in FY13. ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	27.054	26.587	29.393

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*	Project (Number/Name) 624847 / *Rocket Propulsion Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
624847: *Rocket Propulsion Technology*	-	49.753	52.651	51.287	-	51.287	53.372	59.068	61.266	60.276	Continuing	Continuing

The FY 2015 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. All efforts are part of the Rocket Propulsion 21 (RP21) program and reviewed by a DoD level steering committee yearly for relevance to DoD missions and achievement of RP21 Goals.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Fuel Technologies	7.600	6.085	6.306
Description: Develop, characterize, and test advanced hydrocarbons, energetics, solid propellants, and monopropellants to increase space launch payload capability and refine new synthesis methods.			
FY 2013 Accomplishments: Analyzed and tested new candidates for potential hydrocarbon fuel additives to improve performance of kerosene. Continued synthesis and downselect processes and scale-up of promising high energy-density materials candidates, identified synthesis process reducing an ingredient's cost 90%. Continued to develop methods and additives to reduce fuel coking in rocket engine environments. Evaluated candidate propellants in advanced combustion devices. Developed and characterized next generation ionic liquids for use in spacecraft and missile defense applications. Developed scale-up capability for advanced solid propellant ingredients, capable of 20 liters.			
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			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 624847 / *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
spacecraft and missile defense applications. Complete scale-up capability for advanced solid propellant ingredients. Evaluate and modify polymeric systems for use in rocket applications. ***FY 2015 Plans:*** Scale up 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. Develop advanced binder systems to enable use of advance solid propellant ingredients with significant improvements over state of the art. Complete scale-up capability to 60 liters for advanced solid propellant ingredients and begin testing these ingredients in large scale motors. Continue development and characterization of next generation ionic liquid propellants for use in spacecraft and missile defense 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 2013 Accomplishments:*** Began efforts looking at multi-injector designs and control effectors. Provided advanced combustion device technology into a hydrocarbon boost demo and to various contractor designs and continue additional analysis on changing designs and concepts. Developed improved understanding of fundamental combustion and fluid flow/heat transfer processes leading to new methodologies for thermal management, scaling, and combustion instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large numbers of costly full-scale component and engine tests. Evaluated novel nozzle cooling channels for use with hydrocarbon fuels in the high heat flux test rig. Conducted validation and verification of advanced modeling and simulation capabilities. Developed understanding of kerosene production to determine what components affect fuel coking and should be removed from the fuel during the production process. Completed 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. Continue 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. Incorporate data from HCB sub-scale preburner testing into combustion models. 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. Continue characterization of novel cooling channels and transfer info to HCB to influence rocket engine thrust chamber design. Continue developing understanding of hydrocarbon fuel production, what components affect fuel coking and should be removed from the fuel (or	6.742	6.178	6.196

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 624847 / *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
added) during the production process, how can fuels be engineered with a purpose. Continue to evaluate and develop advanced material solutions for high temperature components in rocket engines. ***FY 2015 Plans:*** Continue evaluation of injector concepts in hot fire conditions. Continue efforts looking at multi-injector designs and control effectors. Continue 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. Continue combustion stability modeling critical to supporting Hydrocarbon Boost Demonstration and all future kerosene fueled liquid rocket engines. Complete characterization of novel cooling channels and transfer info to HCB to influence rocket engine thrust chamber design. Continue developing understanding of hydrocarbon fuel production, what components affect fuel coking and should be removed from the fuel (or added) during the production process, how can fuels be engineered with a purpose. Continue to evaluate and develop advanced material solutions for high temperature components in rocket engines. 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: Advanced Material Applications ***Description:*** Develop advanced material applications for lightweight components and material property enhancements for current and future rocket propulsion systems. ***FY 2013 Accomplishments:*** Supported transition efforts of advanced polymers to operational missile systems. Down selected to a single method of material deposition, characterize and document for follow-on development and future potential acquisition programs. Finished nano-material activities. This effort completed in FY13. ***FY 2014 Plans:*** N/A. ***FY 2015 Plans:*** N/A	1.000	-	-
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 2013 Accomplishments:***	12.553	16.589	16.829

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 624847 / *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed enabling hydrocarbon boost technology for future spacelift concepts and continue risk reduction activities for the development of hydrocarbon boost technologies. Developed and demonstrated in-house, moderate scale liquid rocket component testing capability. Completed gas phase and super critical phase testing capability and begin experiments, which is also work supporting risk reduction in hydrocarbon boost. Developed 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). ***FY 2015 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).			
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 2013 Accomplishments:*** Conducted scale-up of advanced monopropellants and evaluate advanced ignition schemes and chamber concepts. Continued development of next generation high power electric spacecraft propulsion. Continued advanced modeling and simulation tool developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies. Began 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 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. Begin initial support for future NASA flight of the Air Force Research Laboratory's AF-M315E non-toxic monopropellant (replaces toxic Hydrazine currently used in spacecraft). ***FY 2015 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	11.813	12.316	12.408

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 624847 / *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
developments to improve design and analysis tools for a wide range of spacecraft propulsion concepts/technologies, incorporating concepts/technologies and accurately model the physics. Continue transition of new thruster modeling framework to spacecraft industry for use in future designs. Explore and develop new generation of chemical spacecraft thruster technologies. Continue support of future NASA flight of AFRL's AF-M315E non-toxic monopropellant (replaces toxic Hydrazine currently used in spacecraft).			
Title: Space Access and Strike Applications ***Description:*** Develop missile propulsion and boost technologies for space access and strike applications. ***FY 2013 Accomplishments:*** 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. Developed 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 combustion and hazards characterization efforts. ***FY 2015 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. Continue propellant development efforts.	6.038	6.755	5.428
Title: Ballistic Missile Technologies ***Description:*** Develop missile propulsion technologies and aging and surveillance technologies for ballistic missiles. ***FY 2013 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. Continued to apply	4.007	4.728	4.120

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 624847 / *Rocket Propulsion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. ***FY 2014 Plans:*** Complete 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. Complete integration of advanced aging and surveillance technologies into full-scale 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. Begin advanced sensor development efforts to further improve data acquisition and reduce uncertainty in ballistic missile life predictions. ***FY 2015 Plans:*** Apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non- destructive analysis tools. Continue advanced sensor development efforts to further improve data acquisition and reduce uncertainty in ballistic missile life predictions. Support transition of previous tools, models, data management system to user.			
Accomplishments/Planned Programs Subtotals	49.753	52.651	51.287

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602203F / *Aerospace Propulsion*	Project (Number/Name) 625330 / *Aerospace Fuel Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625330: *Aerospace Fuel Technology*	-	4.944	5.325	4.971	-	4.971	5.022	5.126	5.226	5.325	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Alternative Fuels	2.250	2.364	2.100
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 2013 Accomplishments:*** Continued 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. ***FY 2015 Plans:*** Evaluate fuel properties from co-processing biomass and petroleum.			
Title: Integrated Thermal and Energy Management	0.990	1.045	1.000
Description: Develop and demonstrate advanced components and conduct performance assessments of advanced aircraft integrated thermal and energy management systems for engines and aircraft. ***FY 2013 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 625330 / *Aerospace Fuel Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Evaluated 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. ***FY 2015 Plans:*** Develop and evaluate nano-catalysts/nano-additives for enhancing heat sink and reducing coking.			
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 2013 Accomplishments:*** Assessed impact of conversion to commercial jet fuel (without military jet fuel additives) on biological growth in base fuel systems. Evaluated 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. ***FY 2015 Plans:*** Evaluate anti-microbial peptides and biological active control for mitigating biological growth an aviation fuels.	0.900	0.958	0.940
Title: Combustion Emissions and Performance ***Description:*** Develop and test advanced emissions diagnostic techniques for airbreathing propulsion systems. Conduct evaluations of the combustion and emissions characteristics of aviation fuels. ***FY 2013 Accomplishments:*** Developed methodology to assess operability of fuels in high pressure combustor rig. ***FY 2014 Plans:*** Evaluate combustor operability of narrow-boiling and high/low cetane alternative fuels as well as fully-synthetic fuels. ***FY 2015 Plans:*** Evaluate advanced in-situ diagnostics to assess in-combustor engine emissions and combustion characteristics.	0.804	0.958	0.931
Accomplishments/Planned Programs Subtotals	4.944	5.325	4.971

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602203F / *Aerospace Propulsion*	**Project (Number/Name)** 625330 / *Aerospace Fuel Technology*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	115.568	127.419	118.343	-	118.343	145.655	181.374	179.506	185.176	Continuing	Continuing
622002: *Electronic Component Technology*	-	28.677	36.188	27.169	-	27.169	34.149	37.253	38.317	39.890	Continuing	Continuing
622003: *EO Sensors & Countermeasures Tech*	-	21.491	23.052	27.980	-	27.980	34.697	44.384	39.842	42.768	Continuing	Continuing
626095: *Sensor Fusion Technology*	-	25.969	25.432	23.486	-	23.486	26.932	31.500	34.334	32.258	Continuing	Continuing
627622: *RF Sensors & Countermeasures Tech*	-	39.431	42.747	39.708	-	39.708	49.877	68.237	67.013	70.260	Continuing	Continuing

The FY 2015 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 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	127.637	127.539	130.587	-	130.587
Current President's Budget	115.568	127.419	118.343	-	118.343
Total Adjustments	-12.069	-0.120	-12.244	-	-12.244
• Congressional General Reductions	-0.283	-0.120			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.257	-			
• Other Adjustments	-10.529	-	-12.244	-	-12.244

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 622002 / *Electronic Component Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622002: *Electronic Component Technology*	-	28.677	36.188	27.169	-	27.169	34.149	37.253	38.317	39.890	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Multifunction Sensor Subsystems	9.432	11.681	8.120
Description: Develop, analyze, demonstrate, and perform engineering trade studies for technologies for compact, affordable, multi-function subsystems for aerospace sensors. ***FY 2013 Accomplishments:*** Completed second round of demonstrations. Using engineering trade analysis, started development of optimized sensor system technology previously demonstrated. ***FY 2014 Plans:*** 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, continue development of optimized sensor system technology. Develop initial trade space models for advanced sensing and electronic warfare front-ends. ***FY 2015 Plans:*** Continue to develop, refine and demonstrate advanced trade space and prediction tools for emerging devices. Complete engineering trade analysis for baseline sensing system technologies. Continue development of trade space models for advanced system of systems sensing and electronic warfare simulations.			
Title: Microelectronic/Optoelectronic Technologies	9.050	13.622	9.036

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Developed optimized device concepts for multi-use cyber, sensing, warfare and communication applications. Developed and demonstrated a capability to predict performance versus lifetime in military relevant environments for a large variety of emerging electronic devices. Identified key failure mechanisms for electronic device technologies and their corresponding accelerants and chemistry. ***FY 2014 Plans:*** Continue 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. ***FY 2015 Plans:*** Complete device concept baseline for multi-use (sense environments and counter threat) applications. Continue to identify and evaluate concepts for compact, high-performance devices and components. Demonstrate projected gains through characterization of test articles in relevant environments. Continue to develop tools and methods to design and analyze game-changing components.			
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 2013 Accomplishments:*** Demonstrated microsystem prototypes. Refined trade analysis. ***FY 2014 Plans:*** N/A. Effort terminated due to higher DoD priorities. ***FY 2015 Plans:*** N/A	4.526	-	-
Title: Antennas ***Description:*** Design and develop antennas for airborne and space-based surveillance. Develop novel and advanced antennas for lightweight, conformal arrays.	5.669	6.305	4.763

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Developed novel antenna concepts for wideband applications. Integrated and demonstrated 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 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. ***FY 2015 Plans:*** Continue to fabricate and characterize innovative devices to extend bandwidth, reconfigurability, tunability and trustworthiness. Continue demonstrations of multi-wavelength, agile and affordable advanced detectors and arrays with emphasis on integrated filtering. Continue the design and fabrication of high-brightness and agile waveform sources to integrate into microsystems 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 (commercial-off-the-shelf(COTS)) with emerging government-off-the-shelf (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 2013 Accomplishments:*** 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. ***FY 2015 Plans:***	-	4.580	5.250

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622002 / *Electronic Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue to identify COTS and GOTS technologies nearly ready or ready for integration into microsystem and subsystem demonstration. Develop, mature and demonstrate solutions utilizing COTs/GOTs technology that enable cyber-hardness, rad-hardness and resistance to tampering.			
Accomplishments/Planned Programs Subtotals	28.677	36.188	27.169

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 622003 / *EO Sensors & Countermeasures Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622003: *EO Sensors & Countermeasures Tech*	-	21.491	23.052	27.980	-	27.980	34.697	44.384	39.842	42.768	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Non-cooperative Detection and Identification Technologies	8.124	11.076	12.435
Description: Develop innovative optical sensing technology for non-cooperative detection and identification of airborne and ground-based targets.			
FY 2013 Accomplishments: Conducted sensor concept demonstrations for long-range target identification using innovative passive and active techniques. Performed longwave hyperspectral change detection experiments to assess model-based algorithms. Conducted laboratory and began field demonstrations of agile multifunction waveforms for long-range, combined temporal synthetic aperture and remote vibrometry waveforms. Began buildup of linear frequency modulation testbed to support long range performance quantification. Developed 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.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622003 / *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Evaluate, via modeling and simulation, innovative sensor concepts to increase long range image quality for passive electro-optical and infrared reconnaissance sensors for high altitude platforms. Mature longwave infrared hyperspectral imaging to achieve operationally useful radiometric sensitivity and area coverage rate with a sensor system that is practical and affordable.			
Title: Innovative Optical Sensing Technologies ***Description:*** Develop innovative optical sensing technology to support military operations in dynamic and urban environments. ***FY 2013 Accomplishments:*** Developed processing methods and sensor requirements for spectral-aided tracking and relocation of targets. Conducted tower demonstrations of multi-aperture transceivers with wavelength and transmitter location diversity. Developed signal processing and automated signature recognition algorithms for remote vibrometry. ***FY 2014 Plans:*** This effort moves to EO/IR Sensors and Threat Countermeasures in this project to better align efforts. ***FY 2015 Plans:*** N/A	0.672	-	-
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 2013 Accomplishments:*** Conducted the assessment of advanced infrared missiles and infrared acquisition sensors. Developed system requirements for Proactive Infrared Countermeasures (PIRCM) to defeat advance infrared (IR) guided missile and IR acquisition and tracking sensors operating in the near to mid-IR bands. Developed and integrated advanced missile warning sensors to demonstrate situational awareness and countermeasure hand-off capabilities. Developed simulation and hardware-in-the-loop test capability to characterize hardware and evaluate/test threat warning and countermeasure concepts. Performed 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. ***FY 2015 Plans:***	2.758	6.215	7.813

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622003 / *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Initiate synthetic aperture ladar (SAL) techniques based on modeling and simulation previously conducted to enhance spatial resolution beyond the diffraction limit of conventional optics through the coherent collection and processing of laser-illuminated scene radiance. Research the problem of improving system capabilities to provide high confidence target identification at standoff ranges for both reconnaissance and targeting platforms. Continue evaluation of prototype Silicon Gallium (SiGa) detectors. Continue design and fabrication of SiGa focal plane array.			
Title: Optical Technologies ***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 2013 Accomplishments:*** Demonstrated high speed and random access optical phased array scanning with photon counting arrays. Demonstrated 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:*** 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. ***FY 2015 Plans:*** Initiate research in the use of vibrometry and range-Doppler sensing technology to aid in target identification and decoy discrimination at ranges at which the imaging performance is insufficient. Research will also supports phenomenology understanding, signature collection, sensor product visualization, and automatic target recognition in collaboration with other AFRL directorates. Continue prototyping of a flexible, next generation long wave infrared hyperspectral imaging spectrometer.	5.271	5.761	7.732
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 2013 Accomplishments:***	4.666	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 622003 / *EO Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed 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 automatic target recognition (ATR). ***FY 2014 Plans:*** This effort moves to EO/IR Sensors and Threat Countermeasure Technologies in this Project to better align efforts. ***FY 2015 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	21.491	23.052	27.980

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 626095 / *Sensor Fusion Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
626095: *Sensor Fusion Technology*	-	25.969	25.432	23.486	-	23.486	26.932	31.500	34.334	32.258	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Automatic Target Recognition Technologies	8.139	9.599	9.500
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 2013 Accomplishments: Enhanced and assessed physics-based techniques to meet the autonomous target detection and identification requirements for ISR applications. Enhanced multisensor, 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 and autonomous sensor, processor, and bandwidth management. Researched bio-inspired automatic target recognition technologies, and assessed and evaluated these techniques for all missions with emphasis on urban applications. Conducted 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:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Develop advanced object recognition methods which correlate data from multiple sensors from air, space and cyber domains. Continue to 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.			
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 2013 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 for automated sensor exploitation of ground targets. Developed signatures, 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 realistic mission environments. Developed 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. ***FY 2015 Plans:*** Continue development of all-source target models for emerging threat systems in contested environments. Create and assess methods for validating all-source signature models. Continue to mature target signature models for signature exploitation of multi-	4.845	4.180	4.080

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
spectral systems and signals intelligence sensors. Mature promising approaches to develop a single target model for application to all parts of the spectrum.			
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 2013 Accomplishments:*** Developed a capability to model the performance of sensor exploitation technologies. Conducted validation of algorithm performance models to be used in the PCPAD-X integrative and virtual environments. 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 2014 Plans:*** 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. ***FY 2015 Plans:*** Develop novel techniques for analysis of large sensor data sets to discover, characterize, and identify threatening activities in contested environments. Continue development of sensor resource optimization enablers for autonomous sensor employment. Continue development and validation of performance models for sensor exploitation technologies. Demonstrate application of sensor and algorithm performance models in the PCPAD-X integrative and virtual environments. Continue to enhance development of an integrated, unified ATR methodology through industry and university outreach.	7.282	6.778	6.500
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 2013 Accomplishments:*** Developed advanced trusted sensing services, middleware, and frameworks for multilayered sensing and spectrum warfare. Developed methods, tools, and processes to determine and assess vulnerability and mission assurance as a function of system scale in complex system-of-systems. Developed methods, tools, and processes to determine and assess vulnerability and mission assurance for complex system-of-systems for spectrum warfare. ***FY 2014 Plans:***	2.267	4.875	3.406

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Initiate research in trusted exploitation algorithms and tools for PC-PAD, defining and quantifying metrics. Build upon previous work in PCPAD-X to research application of trust metrics in the evaluation of COTs, GOTs, and contractor owned exploitation algorithms and tools to assure the mission.			
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 2013 Accomplishments:*** Developed integrated software protection and anti-tamper systems for multilayered ISR sensing systems and spectrum warfare applications. Developed autonomic trusted sensor technologies to address self-aware, self-healing, and self-organizing sensor systems. Initiated development of detect and response mechanisms to remedy software and hardware supply chain vulnerabilities. Initiated 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 Trusted Sensing Technologies in this Project to better align efforts. ***FY 2015 Plans:*** N/A	1.779	-	-
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 2013 Accomplishments:*** Developed avionics system vulnerability testbed. Completed development of advanced avionics bus technologies for trusted sensing. Conducted analysis to exploit wired and wireless avionics sensor systems and began analysis of technologies to protect and defend sensor systems. Initiated assessment of susceptibilities of commercial derivative avionics systems. ***FY 2014 Plans:***	1.657	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 626095 / *Sensor Fusion Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Efforts move to Trusted Sensing Technologies in this Project to better align efforts. ***FY 2015 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	25.969	25.432	23.486

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602204F / *Aerospace Sensors*	Project (Number/Name) 627622 / *RF Sensors & Countermeasures Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
627622: *RF Sensors & Countermeasures Tech*	-	39.431	42.747	39.708	-	39.708	49.877	68.237	67.013	70.260	Continuing	Continuing

The FY 2015 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 radio frequency (RF) sensing and countermeasure concepts for aerospace applications covering the range of RF sensors including communications, navigation, intelligence, surveillance, reconnaissance (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 2013	FY 2014	FY 2015
Title: Hybrid Sensor Technologies	5.524	7.839	7.939
Description: Develop hybrid sensor solutions to be responsive to needs and detect difficult targets. Develop jam-resistant time, position, and velocity sensors.			
FY 2013 Accomplishments: Developed strategies to optimize reference technologies for distributed sensing missions. Explored alternatives when Global Positioning System (GPS) is degraded or denied. Reduced size, weight, and power of inertial components, while pursuing near navigation grade performance.			
FY 2014 Plans: 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.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 627622 / *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Mature GPS augmentation technologies that take advantage of distributed platforms relaying Global Navigation Satellite Systems (GNSS) signals and geo-referenced real-time imaging to improve GPS accuracy in GPS sparse or denied environments. Develop technologies that expand the ability to incorporate GNSS signals into GPS user equipment as a means to improve navigation signal reliability and availability.			
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 2013 Accomplishments:*** Conducted research and development in dismount detection, sparse arrays, polarization diversity, RF tomography, multiple-inputs and multiple-outputs (MIMO) for electronic protection (EP), and Along Track Interferometry (ATI) for ground moving target indicator (GMTI). Conducted outdoor range experimentation for concept verification and validation. Refined and implemented Outdoor Range Open System Architecture. Established 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. ***FY 2015 Plans:*** Continue research and development of agile waveforms, adaptive spectrum utilization techniques, and electromagnetic forensics sensing of the signal environment for robust adaptive RF sensing in contested spectrums and persistent stand-in RF sensing in denied environments. Continue research and development of RF sensor technology, including: signals inteligence (SIGINT) hardware, algorithms, and techniques, passive radar techniques, and advanced receive array antenna technology with wideband and high dynamic range, for passive multimode radars and efficient combat identification capabilities.	7.175	13.778	11.614
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 2013 Accomplishments:***	1.518	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 627622 / *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed signal obstacle course to verify tunable RF architecture using dynamic RF signals. This program used 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 RF Sensor Technologies in this Project to better align efforts. ***FY 2015 Plans:*** N/A			
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 2013 Accomplishments:*** Developed distributed and layered electronic warfare (EW) effects. Explored and analyzed future/on-coming RF-based threats for potential counters and performed vulnerability assessments. Researched advanced electronic support (ES) concepts. Completed research and exploration of an adaptable ES/electronic attack (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. ***FY 2015 Plans:*** Conduct Electro-Magnetic/Electronic Warfare Battle Management (EM/EWBM) research to optimize use of EW assets against current and future integrated air defense systems and RF threats. Identify, develop and integrate improved electronics that reduce cost, size, weight and power of current EW systems to facilitate development of distributed EW jammers/sensor systems. Develop new approaches to protection of aircraft avionics systems and on-board data networks.	5.821	5.895	5.195
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 2013 Accomplishments:***	7.093	5.891	5.616

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 627622 / *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed RF/EO subsystem concept prototype and began its development to validate trade space tools. Refined 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. ***FY 2015 Plans:*** Identify advanced RF/EO subsystem concepts to refine and update trade space capability. Complete the MIMO and waveform-diverse models for system and system of systems analysis. Initiate highly integrated, mostly digital microsystems for reconfigurable and tunable capabilities.			
Title: Complex Clutter Environments ***Description:*** Investigate detection of difficult airborne and ground-based targets in clutter from airborne or space-based surveillance platforms. ***FY 2013 Accomplishments:*** Developed models applicable to MIMO and waveform-diverse systems for multi-sensor networks operating in complex clutter and multi-path environments, and further developed 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 Multi-Band/Multi-Beam Technologies in this Project to better align efforts. ***FY 2015 Plans:*** N/A	2.800	-	-
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 2013 Accomplishments:***	9.500	9.344	9.344

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602204F / *Aerospace Sensors*	**Project (Number/Name)** 627622 / *RF Sensors & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Initiated research on distributed and layered EW effects. Explored and analyzed RF-based threats for potential counters, and performed vulnerability assessments. Initiated 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. ***FY 2015 Plans:*** Develop multi-faceted approaches to countering RF threats. Efforts include development of machine learning, autonomous systems to identify frequency agile and changing waveforms. Develop counter-countermeasures to digital radio frequency memory (DRFM) based jammers. Develop Electromagnetic/Electronic Warfare Battle Management (EM/EWBM) tools, and distributed EW techniques to counter state-of-the-art integrated air defense systems. Develop novel disruptive technologies that leverage cyber, directed energy, and machine learning to counter RF, EO/IR threats.			
Accomplishments/Planned Programs Subtotals	39.431	42.747	39.708

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	88.363	103.955	98.229	-	98.229	108.821	111.632	114.874	117.705	Continuing	Continuing
621010: *Space Survivability & Surveillance*	-	34.601	35.955	35.159	-	35.159	40.742	44.325	45.927	47.001	Continuing	Continuing
624846: *Spacecraft Payload Technologies*	-	18.052	19.098	15.203	-	15.203	16.779	15.692	16.142	16.575	Continuing	Continuing
625018: *Spacecraft Protection Technology*	-	6.383	5.407	8.498	-	8.498	7.525	8.629	9.201	9.411	Continuing	Continuing
628809: *Spacecraft Vehicle Technologies*	-	29.327	43.495	39.369	-	39.369	43.775	42.986	43.604	44.718	Continuing	Continuing

The FY 2015 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.

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	98.375	104.063	109.561	-	109.561
Current President's Budget	88.363	103.955	98.229	-	98.229
Total Adjustments	-10.012	-0.108	-11.332	-	-11.332
• Congressional General Reductions	-0.204	-0.108			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.594	-			
• Other Adjustments	-8.214	-	-11.332	-	-11.332

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 621010 / *Space Survivability & Surveillance*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
621010: *Space Survivability & Surveillance*	-	34.601	35.955	35.159	-	35.159	40.742	44.325	45.927	47.001	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Space Environment Research	6.788	6.403	5.309
Description: Develop technologies for specifying, monitoring, predicting, and controlling space environmental conditions hazardous to DoD operational space systems.			
FY 2013 Accomplishments: Refined the concept-of-operations for solar optical flare specification and prediction unit, and completed the setup of the associated solar optics laboratory. Explored properties of spacecraft materials and novel coatings to understand effects of temperature and aging on spacecraft charging and developed new techniques for charge mitigation. Developed 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. Investigate potential alternatives to traditional solar flare specification and prediction to achieve more accurate predictions. Develop improved solar radio frequency monitoring concepts.			
FY 2015 Plans: Exploit new on-orbit data sources to enhance energetic space environment models supporting spacecraft design and mission planning. Exploit spacecraft material aging research to investigate methods for remote measurement of aging susceptibilities.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue development of solar flare specification and prediction techniques using both ground- and space-based data and modern artificial intelligence techniques.			
Title: Surveillance Technologies ***Description:*** Develop advanced target detection techniques, spectral signature libraries, and decision aids for space-based sensors and surveillance systems. ***FY 2013 Accomplishments:*** Evaluated space-based hypertemporal (HT) sensor performance. Completed HT data processing methodology and investigated HT detection methods for concealed activity monitoring. Conducted trade-space studies of components used in space-based thermal infrared (IR) hyperspectral imaging payloads. Initiated 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 space-based HT sensor performance trade studies. Continue evaluation of HT detection methods for concealed activity monitoring. Discontinued hyperspectral imaging work due to increased emphasis in HT sensor technologies. ***FY 2015 Plans:*** Evaluate HT data processing methods and target detection algorithms. Complete space-based HT sensor performance trade studies. Continue evaluation of HT detection methods for concealed activity monitoring.	9.086	9.538	9.534
Title: Ionospheric Research ***Description:*** Develop techniques, forecasting tools, and sensors for ionospheric specification and forecasting, space-based geolocation demonstrations, and determination of potential radar degradation. ***FY 2013 Accomplishments:*** Incorporated methods to exploit grid-free calculations of plasma processes in the magnetosphere and ionosphere to improve solar weather forecasts. Initiated modeling of energy flow between solar and terrestrial environments. Studied plasma instabilities and processes in the equatorial ionosphere to predict global positioning system (GPS) and communication impacts. Developed plan for increased measurement capabilities in severely under-sampled region for more accurate predictions of communication/ navigation effects. Initiated development of physics-based low earth orbit (LEO) satellite drag prediction tool. ***FY 2014 Plans:*** Continue investigations for physics-based improvements of space weather specification and forecast models related to impacts on DoD systems. Develop improved modeling capability for scintillation impacts on communication, GPS and remote sensing, and for environmentally-induced satellite anomalies, by assimilating space, ground and unexploited data sources. Begin implementing	8.407	6.999	6.689

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
plan for increasing measurements in under-sampled regions for more accurate prediction of radio link degradation. Validate preliminary LEO satellite drag prediction tool and improve by assimilating satellite observations. Define requirements and implement a baseline ionospheric simulation and radio frequency illumination capability for high frequency (HF) geolocation and radar systems; initiate model and data utility trade studies; begin development of advanced simulation techniques. ***FY 2015 Plans:*** Continue investigations for physics-based space weather specification and forecast models related to impacts on DoD systems. Validate improved modeling capabilities for scintillation impacts on communications, GPS and remote sensing, and for environmentally-induced satellite anomalies. Begin development of next model increments. Integrate and quantitatively assess environmental models and system impact data across the solar, magnetosphere, and ionosphere domains to expand capabilities for actionable attribution and forecast of environmentally-caused anomalies on DoD satellites and environmental interference with electromagnetic wave propagation. Incorporate advanced ionospheric sounding techniques and traveling ionospheric disturbance effects into simulation model for next generation radar systems. Conduct application-specific trade studies for model components and data types. Demonstrate HF geolocation coordinate registration capability.			
Title: Radiation Remediation Research ***Description:*** Conduct Radiation Belt Remediation (RBR) research through developing and validating analytical and performance models for remediation of Earth radiation belts following high altitude nuclear detonation. ***FY 2013 Accomplishments:*** Conducted research to characterize the interactions of radio waves and charged particles in the earth's radiation belts using satellite experiments. Applied understanding of very low frequency (VLF) propagation from space sources and the resulting wave particle interactions. Developed a validated end-to-end model to assess the feasibility of a fielded RBR system. ***FY 2014 Plans:*** 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. ***FY 2015 Plans:*** Validate RBR end-to-end model version 2.0 using ground and space-based measurements with the very low frequency particle mapper and satellite experiments. Conduct fielded RBR capability assessments to determine rough order fielded system requirements.	3.882	3.158	3.529
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.	6.438	5.777	5.292

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Migrated unified models of seismic calibration and wave propagation in Eurasia to three-dimensional physics-based models. Began extending coverage of unified model to all of Eurasia. Tested 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. ***FY 2015 Plans:*** Assess relative utility of different scientific and computational advances for improving the accuracy of three-dimensional seismic wave propagation models. Explore use of details of seismic signals in three-dimensional models for discrimination of explosions from earthquakes. Extend coverage and increase resolution of unified model.			
Title: Alternative Navigation Technologies ***Description:*** Develop new technologies based on cold atom physics that provide autonomous jam-proof precision inertial navigation to augment Global Positioning System (GPS) in case of GPS-denial. Develop atomic clocks based on new technologies to replace legacy GPS atomic clocks. ***FY 2013 Accomplishments:*** 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 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. ***FY 2015 Plans:*** Continue to advance the development of compact atomic clocks with improved accuracy and stability to replace legacy atomic clocks. Continue construction of a free space, cold atom 3-axis gyroscope/accelerometer that would enable GPS-free precision navigation. Test a completed free space, cold atom single-axis gyroscope/accelerometer to learn about its strengths and limitations. Continue development of a confined cold atom gyroscope with reduced size and weight over free space cold atom gyroscopes to expand GPS-free navigation to a larger number of Air Force platforms.	-	4.080	4.806
Accomplishments/Planned Programs Subtotals	34.601	35.955	35.159

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 621010 / *Space Survivability & Surveillance*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 624846 / *Spacecraft Payload Technologies*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
624846: *Spacecraft Payload Technologies*	-	18.052	19.098	15.203	-	15.203	16.779	15.692	16.142	16.575	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Space-Based Detector Technologies	3.638	4.471	0.982
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 2013 Accomplishments:*** Researched predictive capability for next generation large format detector array and readout array technology challenges toward Wide Area, Global Access Detection and Tracking. Developed alternative, lower-cost detector materials that operate at higher temperatures for the persistent surveillance mission. Explored theoretical and experimental electronic transport and tenability studies in semiconductors to improve detector sensitivity and operation. ***FY 2014 Plans:*** Continue to develop innovative alternative materials/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. ***FY 2015 Plans:*** Continue to develop and mature an alternative sensor material system to include: increased operating temperature, reduced non-uniformity, and reduced cost. Explore novel detector enhancement methodologies (radiation hardening techniques, detector architectures, etc.) to mainstream visible-long wavelength infrared focal plane array developments.			
Title: Space Situational Awareness Sensing (SSA) Research	1.095	4.031	3.102

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Initiated predictive modeling capabilities for select sensing methods and phenomena. Developed theory required and applied to a variety of space awareness mission threads and potential threat scenarios. Verified and validated decision-critical information mapping exercise results. Completed 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. ***FY 2015 Plans:*** Begin execution of experiment campaign to measure satellite components to verify and validate predictive modeling capabilities against these laboratory and field measurements. Begin systems analysis to establish performance requirements under validated threat scenarios. Initiate next-generation analysis of sensing methods and phenomena to exploit for space protection.			
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 2013 Accomplishments:*** Investigated hardening techniques to protect satellites from high power microwaves. Researched advanced system-on-chip integration for improved performance of space sensor systems. Developed 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. ***FY 2015 Plans:***	6.245	4.918	3.684

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Complete development of integrated modules using three-dimensional techniques to increase throughput while reducing size, weight, and, especially, power. Explore new transistor designs that are compatible with current manufacturing techniques but more efficient and radiation tolerant at ultra-small feature sizes (e.g., 7nm). Expand on-going electronic device reliability research into other failure modes (e.g., hot carrier injection) to understand defects responsible for reduced lifetimes in small feature-size electronic devices. Continue exploration of successful integration techniques for system-on-chip integrated circuits.			
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 2013 Accomplishments:*** Refined and tested spacecraft simulations that model system performance, mission planning, and experiments for future flight experiments. Developed a data center to be able to archive telemetry from flight experiments. ***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. ***FY 2015 Plans:*** Continue to develop spacecraft and mission simulations in close conjunction with customers across the DoD. Continue to integrate state-of-the-art system performance and mission planning algorithms into modeling and simulation software tools. Revise flight tools based on recent flight program experience. Support technology development and maturation through capability and mission utility studies and size, weight, and power-cost trade studies.	7.074	5.678	4.451
Title: Alternative Positioning, Navigation, and Timing Technology ***Description:*** Identify and develop technologies that enable new, or enhance existing, U.S. positioning, navigation, and timing (PNT) satellite capabilities by increasing resiliency and availability of accuracy, and/or increasing the affordability of providing current capabilities. Develop technologies to meet identified Air Force Space Command/Space and Missile Systems Center PNT space payload technology needs. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:***	-	-	2.984

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 624846 / *Spacecraft Payload Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Conduct experiments to establish the sensitivity of PNT payload units/sub-units to off-nominal operating conditions and to establish laboratory readiness for incorporation of experimental hardware from other, on-going PNT technology developments. Conduct studies to identify alternative and innovative technology options for PNT payloads.			
Accomplishments/Planned Programs Subtotals	18.052	19.098	15.203

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 625018 / *Spacecraft Protection Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625018: *Spacecraft Protection Technology*	-	6.383	5.407	8.498	-	8.498	7.525	8.629	9.201	9.411	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Threat Warning Research	6.383	5.407	8.498
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 2013 Accomplishments:*** Developed advanced on-orbit threat detection, assessment, and response technologies, including data processing and handling for course of action determination, space-based tasking, co-orbital threat detection, and autonomous response. Demonstrated situational awareness system in operational environment. Developed and obtained initial operating capability for situational awareness testbed. Reduced 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-decision capabilities. Develop improved sensor algorithms and data fusion techniques. Continue to reduce size, weight, and power requirements for next generation proximity detection sensors. ***FY 2015 Plans:*** Down select and mature next generation proximity detection sensor technologies and sensor suite integration. Provide technology support for the Joint Space Operations Center (JSpOC) Mission Systems Service Pack 7. Begin instantiation of JSpOC Mission Systems (JMS) space situational awareness testbed. Develop SSA closed loop simulation showing automated threat detection and response actions. Evaluate technologies to enable better monitoring of space objects in geosynchronous orbit.			
Accomplishments/Planned Programs Subtotals	6.383	5.407	8.498

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 625018 / *Spacecraft Protection Technology*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602601F / *Space Technology*	Project (Number/Name) 628809 / *Spacecraft Vehicle Technologies*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
628809: *Spacecraft Vehicle Technologies*	-	29.327	43.495	39.369	-	39.369	43.775	42.986	43.604	44.718	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Space Power/Thermal Research	5.687	5.439	4.491
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 2013 Accomplishments:*** Increased cryocooler efficiency from 12% to 30% through modeling, energy analysis of single and multi-stage coolers, and cross gimbal/distributed cooling. Researched effective low and zero vibration cryocooler technologies, including solid state coolers. Investigated approaches and concepts for development of greater than 40% efficient solar cells. Developed 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 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. ***FY 2015 Plans:*** Continue to examine new solid state, zero vibration cryocooler methods. Perform studies on how new solid state technologies may be integrated directly to a focal plane array to show representative thermal loading. Continue development of greater than 40% efficient solar cell approaches. Investigate advanced photon management approaches. Continue optimizing flexible solar array for mass and volume efficiency.			
Title: Space Structures and Controls Research	4.998	10.702	7.884

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Produced experimental flight hardware for thermal management systems requiring high power input. Developed capabilities for characterizing novel, structural materials in a relevant environment. Completed design tools for automated guidance, navigation, and control subsystem for spacecraft. Demonstrated and transitioned advanced estimation-based algorithms for search, detect, and track of space objects. Developed advanced dynamic analysis methods for spacecraft relative motion applications; validated improved spacecraft thruster models in relevant environment; initiated new techniques supporting debris mitigation, including passive (fuel free) techniques for de-tumbling debris to allow for easier removal; initiated new research in collaborating autonomous spacecraft guidance, navigation, and control techniques supporting distributed spacecraft missions. Developed next-generation electronics to enable rapid spacecraft build and reduce spacecraft cost. Demonstrated 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 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. ***FY 2015 Plans:*** Improve and refine collaborative autonomous spacecraft guidance, navigation, and control efforts supporting distributed spacecraft missions. Continue efforts to integrate guidance, navigation, and control methods with advanced spacecraft autonomy decision architectures. Integrate multi-spacecraft and autonomous spacecraft efforts to establish multiple autonomous spacecraft technology capability. Develop improved constitutive models for composite materials. Continue research to improve the fabrication and manufacture of precision and high tolerance composite structures. Perform research in thermal management technologies for heat dissipation of high power and high energy density electronics. Continue to develop analytic and numerical tools and demonstrate multi-physics optimization of satellite structures.			
Title: Space Experiments ***Description:*** Develop flight experiments to improve the capabilities of existing operational space systems and to enable new transformational space capabilities. ***FY 2013 Accomplishments:***	14.666	21.228	20.947

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Initiated 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. ***FY 2015 Plans:*** Continue pre-launch preparations, launch the on-orbit radiation remediation proof-of-concept experiment. Perform launch and early orbit activities and then on-orbit satellite experiments operations. Continue science payload design and long lead procurement for maneuverable geosynchronous space vehicle experiment. Verify system design for science data collections. Verify payload subsystem hardware and software after component/subsystem delivery. Prepare for component/subsystem tests, complete experiment planning for maneuverable geosynchronous experimental platform design payload configurations, and begin to prepare for final spacecraft integration and test. Complete VPM space vehicle assembly integration and test.			
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 2013 Accomplishments:*** Conducted research and developed 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 was 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:*** 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. ***FY 2015 Plans:*** Continue applied research and development efforts (modeling, simulation, and laboratory testing) to reduce component technical risks and to meet technology needs. Specifically, work to develop a propagation flight experiment to characterize the W and	3.976	6.126	6.047

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602601F / *Space Technology*	**Project (Number/Name)** 628809 / *Spacecraft Vehicle Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
V frequency bands for future military satellite communications. Begin evaluation of optical communication links with small spacecraft.			
Accomplishments/Planned Programs Subtotals	29.327	43.495	39.369

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602602F / *Conventional Munitions*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	70.039	81.521	87.387	-	87.387	97.399	105.100	105.023	105.419	Continuing	Continuing
622068: *Advanced Guidance Technology*	-	29.914	32.801	40.757	-	40.757	46.084	49.015	48.188	47.544	Continuing	Continuing
622502: *Ordnance Technology*	-	40.125	48.720	46.630	-	46.630	51.315	56.085	56.835	57.875	Continuing	Continuing

The FY 2015 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, 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	77.175	81.521	84.722	-	84.722
Current President's Budget	70.039	81.521	87.387	-	87.387
Total Adjustments	-7.136	-	2.665	-	2.665
• Congressional General Reductions	-0.150	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.513	-			
• Other Adjustments	-6.473	-	2.665	-	2.665

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.

Increase in FY15 due to increased emphasis on advanced positioning, navigation and timing technologies.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / *Conventional Munitions*	Project (Number/Name) 622068 / *Advanced Guidance Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622068: *Advanced Guidance Technology*	-	29.914	32.801	40.757	-	40.757	46.084	49.015	48.188	47.544	Continuing	Continuing

The FY 2015 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, GPS-degraded and GPS-denied, networked, and autonomous precision munition guidance capability; increased number of kills per sortie; increased aerospace vehicle survivability; improved weapon reliability and affordability; and improved weapon survivability and effectiveness.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Seeker Technologies	3.200	6.800	9.000

Description: Develop seeker technologies for air-delivered munitions to provide high confidence target discrimination and classification, precise target location, and robust terminal tracking.

FY 2013 Accomplishments:

Developed technologies to 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. Increased emphasis on developing seeker technologies that provide enhanced mission capability for fifth-generation aircraft, specifically as it applies to success in denied or anti-access environments. Continued developing algorithms and processing technologies to acquire and track targets with and without an operator-in-the-loop. Developed bio-inspired seeker technologies to increase immunity to countermeasures, exploit multi-discriminant signatures, and 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 (WFOV) sensors, particularly with bio-inspired and high rate processing characteristics.

FY 2015 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602602F / *Conventional Munitions*	**Project (Number/Name)** 622068 / *Advanced Guidance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. Continue to emphasize high-resolution WFOV sensors, particularly with bio-inspired and high rate processing characteristics to allow precise munition terminal guidance in degraded, contested environments.			
Title: Aerodynamics, Navigation and Control Technologies ***Description:*** Develop weapon aerodynamic, control, navigation, and networking technologies for air-delivered munitions to provide precise, agile flight, networked effects, and immunity to countermeasures. ***FY 2013 Accomplishments:*** Continued developing technologies that achieve precision navigation under GPS-degraded and GPS-denied conditions. Developed weapon navigation and control networking technologies to provide options for 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. Increased emphasis in trusted terminal guidance and targeting flexibility/autonomy after long ingress and 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 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. ***FY 2015 Plans:*** Increase emphasis in developing 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 environments, facilitate agile and maneuverable weapons, foster autonomy, trust, and networking, and enable precise munition control and actuation. Continue to investigate multi-functional, multi-strategy weapon swarms to defeat enemy defenses. Develop technologies for weapon-platform interfaces that enable flexible, reprogrammable load-outs and achieve hardware and software modularity.	18.114	19.000	24.000
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 2013 Accomplishments:***	8.600	7.001	7.757

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602602F / *Conventional Munitions*	**Project (Number/Name)** 622068 / *Advanced Guidance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Investigated precision guided munition integration technology issues and functionality. Developed the capability to simulate, test, and refine pioneering seeker concepts and navigation and control approaches in a realistic operational environment. Increased development efforts for guidance integration and evaluation technologies that provide enhanced mission capability for fifth-generation aircraft. Continued pursuing multi-weapon search and attack technologies on a time critical moving target. Established 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. Improve test technologies for evaluating higher speed weapon guidance subsystems. ***FY 2015 Plans:*** Continue to develop a modular radio-frequency hardware-in-the-loop capability to support munitions concepts with high speed target engagement. Continue developing new infrared projection capabilities to evaluate a new class of multi-aperture sensor systems. Continue to develop a real-time radar/millimeter wave signature generation capability for testing algorithms in real-time software and hardware in-the-loop environments.			
Accomplishments/Planned Programs Subtotals	29.914	32.801	40.757

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602602F / *Conventional Munitions*	Project (Number/Name) 622502 / *Ordnance Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
622502: *Ordnance Technology*	-	40.125	48.720	46.630	-	46.630	51.315	56.085	56.835	57.875	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Energetic Materials Technology	9.980	10.000	10.000
Description: Investigate and develop energetic materials technology that can maximize weapon lethality, while applying appropriate safety and security features. ***FY 2013 Accomplishments:*** Developed, modeled, and tested explosive fills that reduce pre-detonation during warhead penetration. Continued developing low density energetic materials for small munition applications. Demonstrated new nanoenergetic materials that enhance and tailor explosive effects. Developed energetic materials with improved properties to enable the increased capability and capacity of fifth-generation aircraft. ***FY 2014 Plans:*** Continue to develop, model, and test explosive fills that reduce pre-detonation during warhead penetration. 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. ***FY 2015 Plans:*** Continue to emphasize development of energetic materials, including reactive cases, that improve performance and reduce bomb and missile size so as to increase loadout and increase safety. Continue to investigate energetic formulations that increase thermal and vibration tolerance required for very long range, high speed munitions. Continue to develop a virtual design tool for use in material design activities.			
Title: Fuze Technologies	9.700	13.800	13.000

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602602F / *Conventional Munitions*	**Project (Number/Name)** 622502 / *Ordnance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Expanded effort to investigate novel methods to initiate explosives, including new modeling and testing techniques. Increased 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. Continued to investigate and characterize the mechanical environment that a fuze must survive during hard target penetration events. Continued to explore ground profiling imaging fuze technology, and developed 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. ***FY 2015 Plans:*** Continue developing a fuzing system employing ground profiling radar for miniature ordnance packages to enable more lethal forward-firing as well as low collateral damage. Investigate the capability to predict and measure fuze performance during munition penetration at high impact speeds.			
Title: Warhead Technologies ***Description:*** Investigate and develop innovative warhead kill mechanisms, such as adaptable warheads, directional-control fragmenting warheads, and reactive metals. ***FY 2013 Accomplishments:*** Developed novel warhead technologies that enable small, agile munitions to provide the capability to deliver selectable effects on targets. Continued investigating directional warhead concepts to improve standoff kills for non-direct hit encounters by employing reactive fragments and by utilizing a forward focusing fragment capability. Continued 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	11.792	13.900	13.000

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602602F / *Conventional Munitions*	**Project (Number/Name)** 622502 / *Ordnance Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2015 Plans:*** Develop penetrator technologies that address penetrator stability through novel nose shapes and increased survivability through internal structures for high-speed impacts into hard and deeply buried targets. Continue to develop small, multi-output warhead technologies primarily for soft surface targets, but with limited penetration capability for hardened, shallow structures.			
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 2013 Accomplishments:*** Investigated precision guided munition integration issues and functionality in various flight environments. Built interoperable simulations to evaluate emerging technologies. Developed enhanced models with improvements for small munitions, penetrators, and counter chemical, biological, radiological, and nuclear effects. Increased emphasis on pioneering 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. ***FY 2015 Plans:*** Continue to develop mission-level simulation architecture capability to enable weapon system and weapon technology assessments. Continue development of multiphase physics models analyzing the detonation of a warhead and the dispersal of either a neutralizer or fuel. Continue to develop inventive ordnance concepts that increase the capacity and capability of fifth-generation aircraft.	8.653	11.020	10.630
Accomplishments/Planned Programs Subtotals	40.125	48.720	46.630

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602602F / *Conventional Munitions*	**Project (Number/Name)** 622502 / *Ordnance 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-2, RDT&E Budget Item Justification: PB 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602605F / *Directed Energy Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	96.401	112.783	125.955	-	125.955	117.559	120.495	119.591	121.091	Continuing	Continuing
624866: *Lasers & Imaging Technology*	-	71.579	79.760	76.319	-	76.319	78.018	85.948	84.887	85.722	Continuing	Continuing
624867: *Advanced Weapons & Survivability Technology*	-	24.822	33.023	49.636	-	49.636	39.541	34.547	34.704	35.369	Continuing	Continuing

The FY 2015 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 (HELs), including devices, optical beam control, and integration; ground-based optical space situational awareness (SSA); and high power electromagnetics (HPEM). 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 visual characteristics such as status and health of orbiting space objects. In HPEM, 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.

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	106.196	112.845	128.153	-	128.153
Current President's Budget	96.401	112.783	125.955	-	125.955
Total Adjustments	-9.795	-0.062	-2.198	-	-2.198
• Congressional General Reductions	-0.205	-0.062			
• Congressional Directed Reductions	-7.000	-			
• Congressional Rescissions	-	-			
• Congressional Adds	9.000	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.651	-			
• Other Adjustments	-9.939	-	-2.198	-	-2.198

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602605F / *Directed Energy Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Project: 624866: *Lasers & Imaging Technology*		
Congressional Add: *Space Situational Awareness*	8.161	-
Congressional Add Subtotals for Project: 624866	8.161	-
Congressional Add Totals for all Projects	8.161	-

Change Summary Explanation

Decrease in FY13 Congressional Directed Reductions due to delayed research supporting future electronic laser on a large aircraft.
Increase in FY13 Congress Add for enhanced efforts in space situational awareness
Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 Other Adjustments is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / *Directed Energy Technology*	Project (Number/Name) 624866 / *Lasers & Imaging Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
624866: *Lasers & Imaging Technology*	-	71.579	79.760	76.319	-	76.319	78.018	85.948	84.887	85.722	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: High Energy Laser Technologies and Directed Energy Assessments	47.172	52.244	51.192

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 2013 Accomplishments:

Developed 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. Scaled pulsed optically-pumped semiconductor laser in the mid-infrared (eye-safer) wavelength to kilowatt-class peak power. The flowing diode pumped alkali laser effort completed design work on a new laser head that will protect the device windows from rubidium contamination, enabling higher laser performance. Reduced 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. Demonstrated technologies to support pointing and tracking of targets for a ground based demonstration. Evaluated and integrated horizontal propagation compensation concepts for field testing. Conducted beam control research in support of a demonstration of a high power solid state laser with a beam control system on the ground. Developed models incorporating aero-effects on HEL beams projected from the beam control system. Conducted effects testing to establish requirements for aircraft self-protection laser system.

FY 2014 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602605F / *Directed Energy Technology*	**Project (Number/Name)** 624866 / *Lasers & Imaging Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue to conduct research supporting a joint Air Force/Defense Advanced Research Projects Agency (DARPA) ground demonstration of a high power solid state laser with a beam control system. Prepare for future flight tests of beam control technologies. Continue integration and begin testing of horizontal propagation compensation concepts. Begin developing analysis tools including platform, optics, controls, atmospheric effects, and target predictions supporting future weapons analysis for an Integrated Weapons Environment for Analysis (IWEA) to analyze directed and kinetic energy weapons in a common environment to help plan weapons investments. Conduct effects testing to establish system requirements and validate modeling efforts. Design a narrow line width (sub-gigahertz) monolithic fiber amplifier with good beam quality. Begin design of laser system for aircraft self-protection. ***FY 2015 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. Begin integration of beam control technologies and monolithic fiber amplifier for ground to air field tests. Use effects testing to establish system requirements and validate modeling efforts. Evaluate subscale turret beam control technologies. Update and use IWEA to analyze directed and kinetic energy weapons in a common environment to help plan weapons investments. Use intelligence information to evaluate foreign HEL threats and provide weapon system and technology developers with tools and criteria to help protect US systems. Continue design of laser system for aircraft self-protection.			
Title: Optical Space Situational Awareness and Satellite Vulnerability	16.246	27.516	25.127
Description: Develop advanced, long-range, electro-optical technologies that support ground-based optical SSA. Develop and use technologies to better understand the vulnerability of blue satellite systems to lasers. Operated the Starfire Optical Range in support of internal and customer requirements. ***FY 2013 Accomplishments:*** Improved satellite characterization tools, developing algorithms to determine altitude and shape of satellites in geosynchronous orbit. Developed initial capabilities for extending existing imaging techniques into 24-hour operations. Demonstrated the ability to image space objects during extended daylight hours using the 3.6-meter telescope, enabling for the first time the observation of objects in orbit that cannot be viewed at night. ***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. Develop initial capabilities for extending existing techniques into 24-hour operations. Develop technologies to quantify the vulnerability and protection needs of certain blue satellite components. ***FY 2015 Plans:*** Develop dynamic telescope control to keep track of potential threat objects in space. Demonstrate data analysis techniques to understand characteristics of potential space threats and satellite anomalies. Demonstrate capabilities for extending existing			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602605F / *Directed Energy Technology*	**Project (Number/Name)** 624866 / *Lasers & Imaging Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
techniques into 24-hour operations. Evaluate concepts for persistent monitoring of space events and capability to image and search the local space around our high-value satellite assets, including low power testing for those in geosynchronous orbits.			
Accomplishments/Planned Programs Subtotals	63.418	79.760	76.319

	FY 2013	FY 2014
Congressional Add: Space Situational Awareness ***FY 2013 Accomplishments:*** Conducted space situational awareness research. ***FY 2014 Plans:*** N/A.	8.161	-
Congressional Adds Subtotals	8.161	-

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602605F / *Directed Energy Technology*	Project (Number/Name) 624867 / *Advanced Weapons & Survivability Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
624867: *Advanced Weapons & Survivability Technology*	-	24.822	33.023	49.636	-	49.636	39.541	34.547	34.704	35.369	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project explores the use of HPEM and other unconventional/innovative weapon concepts to support applications such as nonlethal counter-personnel and electronic warfare including disruption, degradation, and damage of electronic infrastructure. This research includes weapon technology that can provide covert effects and/or no collateral or human damage. The project also investigates the effects of potential adversary HPEM weapons and how to mitigate those effects on US assets, as well as producing and applying DE and non-DE concept development and assessment tools to determine which technology solutions to pursue. HPEM includes but is not limited to high power microwaves, plasmas, particle beams and millimeter waves.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: HPEM and Unconventional Weapon Technologies	15.715	19.933	30.268
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 2013 Accomplishments:*** Developed technologies to provide frequency agile, broadband sources. Developed state-of-the-art components to shrink antennas, microwave components, and energy storage/prime power technologies. ***FY 2014 Plans:*** Develop state-of-the-art components to further 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. ***FY 2015 Plans:*** Begin ultra-short pulsed laser atmospheric propagation studies. Conduct effects studies on electronics based on the assessments from FY14. Develop compact 50 kilovolt solid state switch. Develop designs for 100 megavolt test facility accelerator. Increase development of technologies leading to more efficient, smaller, lighter, and more powerful HPEM systems.			
Title: HPEM Effects and Mitigation Research	9.107	13.090	19.368

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602605F / *Directed Energy Technology*	**Project (Number/Name)** 624867 / *Advanced Weapons & Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Assess the effects/lethality of HPEM technologies. Develop and apply sophisticated models to enhance the development of HPEM and related technology. Develop tools and perform assessments which allow comparisons among DE concepts and tradeoffs between DE and non-DE solutions. Investigate technologies to counter the effects of HPEM. ***FY 2013 Accomplishments:*** Investigated effects of high bandwidth technologies, exploring issues to exploit/prevent cyber-attack. Developed 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. This is an Air Force/DoD High Performance Computing Modernization Program for the development of advanced, user friendly, modeling and simulation capability for entire HPEM systems. ***FY 2015 Plans:*** Develop source for effects testing that operates in three microwave bands. Complete integration of software into DE High Performance Computing Software Applications Institute, which allows modeling of DE sources and propagation that involves plasmas. Assess potential improvements to US weapons systems from employing HPEM weapons technologies for platform protection and target prosecution. Use intelligence information to evaluate foreign HPEM threats and provide weapon system and technology developers with tools and criteria to help protect US systems.			
Accomplishments/Planned Programs Subtotals	24.822	33.023	49.636

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	94.292	138.145	147.789	-	147.789	167.051	165.701	161.231	166.402	Continuing	Continuing
625315: *Connectivity and Protection Tech*	-	36.908	57.455	65.715	-	65.715	73.824	73.388	69.697	75.486	Continuing	Continuing
625316: *Info Mgt and Computational Tech*	-	24.415	25.862	27.511	-	27.511	32.087	34.843	33.067	32.137	Continuing	Continuing
625317: *Information Decision Making Tech*	-	14.254	15.775	13.191	-	13.191	20.554	15.049	14.969	14.323	Continuing	Continuing
625318: *Operational Awareness Tech*	-	18.715	20.604	20.650	-	20.650	19.275	20.525	22.248	22.774	Continuing	Continuing
62OMMS: *Research Site Support*	-	-	18.449	20.722	-	20.722	21.311	21.896	21.250	21.682	Continuing	Continuing

The FY 2015 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. The Research Site Support project provides the Rome Research Site infrastructure at Rome, NY and provides for the continued operations of all Rome Research Site properties, buildings, and services necessary for the research mission. 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 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	104.362	138.161	147.826	-	147.826
Current President's Budget	94.292	138.145	147.789	-	147.789
Total Adjustments	-10.070	-0.016	-0.037	-	-0.037
• Congressional General Reductions	-0.225	-0.016			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.239	-			
• Other Adjustments	-8.606	-	-0.037	-	-0.037

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625315 / *Connectivity and Protection Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625315: *Connectivity and Protection Tech*	-	36.908	57.455	65.715	-	65.715	73.824	73.388	69.697	75.486	Continuing	Continuing

The FY 2015 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 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 2013	FY 2014	FY 2015
Title: Advanced Connectivity Technologies	14.774	25.824	20.247
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 2013 Accomplishments: Developed advanced networking technologies for distributed military operations in an airborne environment. Conducted 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. Completed the investigation of spatial multiplex Multiple-Input and Multiple-Output (MIMO) techniques to increase channel capacity and the development of a cognitive cooperation protocol for wireless networks.			
FY 2014 Plans: Continue development of 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			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625315 / *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Continue development of 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. Continue the development of a modular airborne network bridge for the creation of an air-air/air-ground secure tactical intranet. Continue the development of wideband, long range, rapidly deployable aerial backbone network for command, control, intelligence, surveillance, and reconnaissance (C2ISR) dissemination. Continue 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 2013 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. ***FY 2014 Plans:*** Continue development of technology to assure operations within a cyber-contested environment by focusing on mission assurance capabilities and avoidance techniques through demonstration of agility and survivability techniques that move faster than the adversary. 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 cyber operations. Complete development of advanced data assurance and threat mitigation technologies. Initiate development of technologies to keep pace with rapidly changing communications networks/devices and deliver a full range of cyber effects to support cyber missions. ***FY 2015 Plans:*** Continue development of technology to assure operations within a cyber-contested environment through the maturation of mission assurance technologies and beginning development of mission aware applications and infrastructure that focus defensive initiatives on assuring mission success as opposed to focusing on network components. Complete prototype mission survival/ recovery framework for operating Air Force missions. Continue development of technologies to keep pace with rapidly changing communications networks/devices and deliver a full range of cyber effects to support cyber missions.	12.286	13.313	21.298
Title: Cyber Offense Technologies	9.428	17.896	19.172

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625315 / *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop offensive cyber operations technologies to access, maintain presence on, and deliver effects to adversary systems. ***FY 2013 Accomplishments:*** Completed development of information system access methods and development of propagation techniques. Developed stealth and persistence technologies. Conducted investigation into anti-reverse engineering methods. Developed methods for increased cyber situational awareness and understanding of the battlefield, and developed methods for covert data exchange. Completed development of technology to deliver effects in concert with cyber platforms. Developed 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. Complete development of a publish/subscribe command and control architecture for exchanging information. Initiate the development of a common operating platform for Air Force operational cyber missions. ***FY 2015 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 the development of a common operating platform for Air Force operational cyber missions.			
Title: Survivability Technologies ***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 2013 Accomplishments:*** Developed 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 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	0.420	0.422	0.402

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625315 / *Connectivity and Protection Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Continue development of defensive cyber technologies to increase system survivability while under a cyber attack. Develop technologies for trusted embedded systems for use within the DoD's most critical information systems. Securely operate within heterogeneous private, public and hybrid environments. Continue research into trust enhanced platform that utilizes virtualization to provide resilient operations.			
Title: Cyber Technologies for Spectrum Warfare ***Description:*** Develop technologies combining electronic warfare, signals intelligence (SIGINT), communications, and cyber technologies that provide synergistic access, exploitation, and effects across air and cyber domains in congested and contested environments. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** Initiate development of active and passive methods to locate, acquire, and process data and signals of interest.	-	-	4.596
Accomplishments/Planned Programs Subtotals	36.908	57.455	65.715

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625316 / *Info Mgt and Computational Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625316: *Info Mgt and Computational Tech*	-	24.415	25.862	27.511	-	27.511	32.087	34.843	33.067	32.137	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Dissemination Technologies	4.519	5.259	6.716
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 2013 Accomplishments: Developed 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. Initiated 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			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625316 / *Info Mgt and Computational Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
processing of large data sets within mission timeline constraints. Initiate development of responsive autonomous control for tactical sensor control. ***FY 2015 Plans:*** 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. Continue 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 2013 Accomplishments:*** Developed advanced computing techniques, enabling superior information processing for Air Force warfighters through in-house and university research. Completed development of tools to analyze code and dynamic execution profiles and extract threads suitable for multi-core computation. Developed petaflops embedded processing on-demand and multi-core computing by demonstrating increased control of power of fabricated prototype. Completed study of quantum cores as the foundational building blocks for a multi-core quantum processor. ***FY 2014 Plans:*** Continue development of 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 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. ***FY 2015 Plans:*** Continue development of 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. Initiate research to develop computational systems that adapt and evolve their dynamic context based on prior experiences.	12.306	11.058	9.029
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.	3.323	4.865	6.302

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625316 / *Info Mgt and Computational Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Developed an automated security annotation framework that provides safeguarding mechanisms for the Air Force enterprise. Developed 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 Global Information Grid (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-Internet Protocol (VOIP) and video tele-confrence (VTC) content filters for allowing real time domain voice and video communications across coalition partners. Initiate development and demonstration of multi-level security trust, speed, and cost advancements for global network operations access/connectivity. ***FY 2015 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. Deliver a suite of new U.S./coalition collaboration services producing four new cross-domain capabilities: voice/video; full motion video streaming; automated content inspection; and global trusted remote management. Continue development and demonstration of multi-level security trust, speed, and cost advancements for global network operations access/connectivity.			
Title: Advanced Architectural Technologies	4.267	4.680	5.464
Description: Develop the architectural mechanisms that form the basis for predictable software and high assurance systems. ***FY 2013 Accomplishments:*** Completed development of a trusted, automated cyber defense capability to reduce response time down to milliseconds vice hours. Developed the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Completed 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 multiple independent levels of security (MILS) systems. Completed design of a hybrid complementary metal-oxide-semiconductor (CMOS)/ memristor logic unit that is compact and efficient for encryption algorithm implementation. ***FY 2014 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625316 / *Info Mgt and Computational Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Continue the development of the tools, techniques, standards, and technologies required to build highly complex software-intensive systems. Complete research to reduce power draw of embedded systems to enable sufficient performance to achieve autonomy and/or more on board processing. Initiate research to develop and demonstrate a processor with design features that permits the maintaining of control of embedded computing systems in a contested environment.			
Accomplishments/Planned Programs Subtotals	24.415	25.862	27.511

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625317 / *Information Decision Making Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625317: *Information Decision Making Tech*	-	14.254	15.775	13.191	-	13.191	20.554	15.049	14.969	14.323	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Campaign Planning Technologies	10.219	8.886	8.220

Description: Develop advanced monitoring, planning, and assessment technologies enabling aerospace commanders to develop effects-based campaigns.

FY 2013 Accomplishments:

Developed decision theory and initiated the development of a capability for autonomous adaptive re-planning in a real-time simulation environment using a case-based planning system. Investigated full-spectrum, quantitative analysis techniques that aid operational assessor's ability to link actions to effects to desired objectives. Initiated development of robust autonomous control algorithms for heterogeneous and distributed assets capable of learning in dynamic environments.

FY 2014 Plans:

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. Initiate development of evaluation services to determine operational planning feasibility. Complete 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. Initiate research and development in cooperative agency and group transfer learning.

FY 2015 Plans:

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 development of evaluation services to determine operational planning feasibility. Continue development of robust autonomous control algorithms for heterogeneous and distributed

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625317 / *Information Decision Making Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
assets capable of learning in dynamic environments. Continue research and development in cooperative agency and group transfer learning.			
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 2013 Accomplishments:*** Completed 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. Conducted in-house and university development of planning, decision-making, and course of action (COA) tools supporting the commander's ability to exercise a wide range of command and execution options for Air Force forces. Developed 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 planning, decision making, and COA tools supporting the commander's ability to exercise a wide range of command and execution options for Air Force assets. 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 algorithm automated decision aids for obtaining a comprehensive situational awareness and timely assessments of executing operations within and across the air, space and cyber domains to achieve desired effects. Initiate research for the orchestration of the dynamic employment of multiple moving target defense components, configurations and services across the information enterprise to ensure the mission. ***FY 2015 Plans:*** Complete development of planning, decision making, and COA tools supporting the commander's ability to exercise a wide range of command and execution options for Air Force assets. Continue development of techniques for visualizing cyber situational awareness, and assuring Operations Center functionality while under cyber attack. Complete development of techniques for appropriately selecting cyber assets to achieve desired effects. Continue research and development of automated decision aids for obtaining timely assessments of executing operations within and across the air, space and cyber domains. Continue research for the orchestration of the dynamic employment of multuiple moving target defense components, configurations and services across the information enterprise to ensure the mission.	4.035	6.889	4.971
Accomplishments/Planned Programs Subtotals	14.254	15.775	13.191

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625317 / *Information Decision Making 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 625318 / *Operational Awareness Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
625318: *Operational Awareness Tech*	-	18.715	20.604	20.650	-	20.650	19.275	20.525	22.248	22.774	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Multi-Source Fusion Technologies	11.488	12.429	12.841
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 2013 Accomplishments: Completed 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. Developed techniques for performing indications and warnings, pattern recognition, and information fusion for information exploitation. Completed development of techniques and algorithms to improve analysis of multi-sensor data for mining data across multi-intelligence (INT) repositories for behavioral patterns to identify terrorist networks, track movement, process moving-target indication data from airborne sensors, and automatically classify airborne targets including remotely piloted aircraft (RPA). Conducted in-house and university research dealing with 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. Developed software to aid the analyst in determining the entity's behavior, including direction, speed, maneuvers, and operation of equipment.			
FY 2014 Plans: Develop additional capabilities to take advantage of processing (as a service) and storage (as a service) features of cloud-based computing for advanced analytics against radar and optical data. Deliver baseline activity-based intelligence tools. Complete			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625318 / *Operational Awareness Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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, track movement, process moving-target indication data from airborne sensors, and automatically classify airborne targets including RPA. Continue in-house and university research dealing with fusion of 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 text analysis multi-source/document data association and resolution techniques. Consolidate and associate data across disparate information sources. Continue research into machine learning to improve Planning and Direction, Collection, Processing and Exploitation, Analysis and Production, and Dissemination (PCPAD). ***FY 2015 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 the information 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 research into machine learning to improve PCPAD. Demonstrate tool developments in a contested scenario. Complete development of text analysis capabilities enabling analysts to efficiently extract/consolidate information from massive amounts of textual data; ID enemy entity-relation networks from that infomation; and develop/ maintain an understanding of the networks over time. Continue to develop activity-based intelligence capabilities for characterizing and locating activities and transactions.			
Title: Exploitation Technologies	5.593	5.652	4.529
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 2013 Accomplishments:*** Completed the development, test, and evaluation of real-time, tactical information exploitation software using laboratory tools and operational data. Developed a wide variety of exploitation methods to enhance signals exploitation of modern emerging signals expected from contested environments and increase situational awareness. Conducted 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:***			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 625318 / *Operational Awareness Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue development of a wide variety of exploitation methods to enhance signals exploitation of modern emerging signals expected from contested environments and increase situational awareness. Continue development of multi-domain raw signal exploitation techniques. 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. ***FY 2015 Plans:*** Continue development of a wide variety of exploitation methods to enhance signals exploitation of modern emerging signals expected from contested environments. Develop real-time audio processing technology to improve the extraction, analysis and reporting of tactical information. Continue development of multi-domain raw signal exploitation techniques. 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 2013 Accomplishments:*** Completed development of tools for the analyst to identify the optimum set of leverage points to meet commander's objectives. Completed the identification of degree to which the adversary can achieve hypothesized COAs based on predicted goals. Completed 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. ***FY 2015 Plans:*** Continue 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. Continue to add targeting capabilities to increase the full range of options available. Continue to assess target folder integration techniques of developed kinetic and non-kinetic tools.	1.634	2.523	3.280
Accomplishments/Planned Programs Subtotals	18.715	20.604	20.650

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602788F / *Dominant Information Sciences and Methods*	Project (Number/Name) 62OMMS / *Research Site Support*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
62OMMS: *Research Site Support*	-	-	18.449	20.722	-	20.722	21.311	21.896	21.250	21.682	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Rome Research Infrastructure	-	18.449	20.722

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 2013 Accomplishments:
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 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

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602788F / *Dominant Information Sciences and Methods*	**Project (Number/Name)** 62OMMS / *Research Site Support*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Provide civilian payroll and non-pay costs for installation operations in support of the Rome Research Site property and all onsite personnel. Provide facilities, facility operations, facility sustainment, support equipment, contracts and associated costs 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	-	18.449	20.722

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602890F / *High Energy Laser Research*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	34.233	40.155	37.496	-	37.496	42.316	42.636	43.405	44.054	Continuing	Continuing
625096: *High Energy Laser Research*	-	34.233	40.155	37.496	-	37.496	42.316	42.636	43.405	44.054	Continuing	Continuing

The FY 2015 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) 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.

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	38.557	40.217	41.575	-	41.575
Current President's Budget	34.233	40.155	37.496	-	37.496
Total Adjustments	-4.324	-0.062	-4.079	-	-4.079
• Congressional General Reductions	-0.051	-0.062			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.050	-			
• Other Adjustments	-3.223	-	-4.079	-	-4.079

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602890F / *High Energy Laser Research*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Robust Electric Laser Initiative	10.986	9.290	5.870
Description: Advance solid-state laser development. ***FY 2013 Accomplishments:*** Continued a joint high power electric laser product improvement program, as part of the Robust Electric Laser Initiative (RELI) effort. Selected two efforts to build a 60 kilowatt (kW) and a 30kW laser source for integration on relevant military platforms. Prepared 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 60kW and 30kW laser source development for integration onto relevant military platforms. Analyze trade space to understand performance and integration issues for other platforms. Continue investigation into other laser architectures for further development and scaling and initiate additional effort(s). Finalize preparations and equipment for government-sponsored measurements to validate performance. ***FY 2015 Plans:*** Continue the joint high power electric laser product improvement program, as part of the RELI effort. Monitor technical progress of the 60kW and the 30kW lasers and other sources. Monitor preparation for integration onto specific relevant military platforms. Continue analysis of trade space to understand performance and integration issues for other platforms. Perform government-sponsored measurements to validate performance.			
Title: Solid State Laser Technologies	5.797	6.365	5.336
Description: Mature technologies that will provide system level performance commensurate with fieldable solid-state laser devices. ***FY 2013 Accomplishments:*** Developed highly efficient, compact, modular electric laser system component technologies. Advanced technology for laser gain material, improved heat extraction, and novel fiber architectures. Conducted a Service and Agency call for FY13 and awarded nine new projects. ***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. ***FY 2015 Plans:***			

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602890F / *High Energy Laser Research*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Develop high reliability, lower cost, efficient and high temperature diode pump sources. Scale alternate laser wavelengths to militarily relevant power levels. Develop high power delivery fiber technologies. Conduct a reduced Service and Agency call for FY15.			
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 2013 Accomplishments:*** Demonstrated technologies for a 100KW lab demonstration, with emphasis on technologies that can support 1 megawatt future FEL performance. ***FY 2014 Plans:*** Demonstrate technologies that can support 100kW future FEL performance. Conduct an industry proposal call for FY14. ***FY 2015 Plans:*** Complete technologies that can support 100kW future FEL performance. Effort transitioned to Navy program 0602114N.	0.475	0.500	0.200
Title: Advanced High Energy Laser (HEL) Technologies ***Description:*** Investigate new technologies that have revolutionary potential HEL applications. ***FY 2013 Accomplishments:*** Explored novel laser technologies to improve efficiency and decrease mass/volume. Evaluated new materials for HEL applications, to include optics in a high-gain vacuum. Continued to scale electrically pumped alkali laser pump sources to increased power levels. Performed system study of diode pumped alkali lasers. Demonstrated applications for short pulse laser technology. Conducted a Service and Agency call for FY13 and awarded three new projects. ***FY 2014 Plans:*** Explore novel laser technologies to improve efficiency and decrease mass/volume. Evaluate new materials for HEL 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. In close coordination with the HEL, air space control, and satellite communities establish and begin a Predictive Avoidance and Air Space Deconfliction (PAAD) program to develop a prototype standalone capability that will interface with aviation, surface and space situational awareness systems and an HEL weapons systems to demonstrate an initial capability. Conduct an industry proposal call for FY 2014. ***FY 2015 Plans:***	3.946	8.800	7.490

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602890F / *High Energy Laser Research*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Explore novel laser technologies to improve efficiency and decrease mass/volume. Evaluate new materials for HEL applications. Continue to improve understanding of short pulse laser technology to include material interaction and propagation. Continue to scale electrically pumped alkali lasers to KW-class power levels. Continue development of the PAAD system and begin initial testing on HEL test range(s). Conduct a reduced Service and Agency call for FY15.			
Title: Laser Beam Control Technologies ***Description:*** Develop technology to support high performance beam control systems and integrated demonstrations. ***FY 2013 Accomplishments:*** Developed beam control technologies for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems) and in stressing environments. Began development of a predictive avoidance fire control system for use on multiple platforms. Conducted a Service and Agency call for FY13 and awarded seven new projects. ***FY 2014 Plans:*** Continue development of beam control technologies for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems) in stressing environments. Continue development of a predictive avoidance fire control system for use on multiple platforms. Develop and begin execution of a program plan for joint beam director technologies to improve throughput efficiency and decrease weight. Develop and begin execution of a program plan for kill assessment technologies. Conduct an industry proposal call for FY14. ***FY 2015 Plans:*** Continue development of beam control technologies for laser weapon use on multiple platforms (aircraft, ground vehicles and shipboard systems) in stressing environments. Continue development of a predictive avoidance fire control system for use on multiple platforms. Continue execution of the program plan for joint beam director technologies to improve throughput efficiency and decrease weight. Continue execution of a program plan for kill assessment technologies. Conduct a Service and Agency call for FY15. Initiate a joint beam control product improvement program to accelerate and advance the development of HEL beam control hardware and technologies for HEL weapon system prototypes.	6.717	8.290	12.050
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 2013 Accomplishments:***	3.357	3.590	3.630

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602890F / *High Energy Laser Research*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
In close coordination with existing HEL models, integrated lethality data into campaign-level HEL system models. Conducted laser vulnerability experiments on materials, components, and targets. ***FY 2014 Plans:*** 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 2015 Plans:*** 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.			
Title: High Energy Laser (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 2013 Accomplishments:*** Provided maintenance, verification, validation, and accreditation for updated system level HEL models. Conducted mission-level HEL engagement scenarios and wargame HEL concepts. Incorporated 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. Continue development of a risk assessment for illumination of objects in space by tactical laser weapons. ***FY 2015 Plans:*** Provide maintenance, verification, validation, and accreditation for updated system level HEL models. Conduct mission-level HEL engagement scenarios and wargame HEL concepts. Incorporate predictive avoidance modeling into existing HEL toolkit. Continue development of a risk assessment for illumination of objects in space by tactical laser weapons.	2.955	3.320	2.920
Accomplishments/Planned Programs Subtotals	34.233	40.155	37.496

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602890F / *High Energy Laser Research*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	54.334	54.572	32.177	-	32.177	39.975	39.075	38.819	40.576	Continuing	Continuing
632100: *Laser Hardened Materials*	-	18.643	20.450	17.285	-	17.285	15.934	17.381	17.127	17.496	Continuing	Continuing
633153: *Non-Destructive Inspection Development*	-	7.015	6.766	5.275	-	5.275	5.558	6.601	6.383	6.478	Continuing	Continuing
633946: *Materials Transition*	-	27.582	27.356	9.617	-	9.617	18.483	15.093	15.309	16.602	Continuing	Continuing
634918: *Deployed Air Base Demonstrations*	-	1.094	-	-	-	-	-	-	-	-	Continuing	Continuing

The FY 2015 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: hardened materials technologies for the protection of aircrews and sensors; non-destructive inspection and evaluation technologies; transition data on structural and non-structural materials for aerospace applications; and 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 Science and Technology 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	47.890	39.572	35.229	-	35.229
Current President's Budget	54.334	54.572	32.177	-	32.177
Total Adjustments	6.444	15.000	-3.052	-	-3.052
• Congressional General Reductions	-0.080	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	13.000	15.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.049	-			
• Other Adjustments	-5.427	-	-3.052	-	-3.052

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Project: 633946: *Materials Transition*		
Congressional Add: *Materials Research and Technology*	11.830	10.000
Congressional Add: *Metals Affordability Research*	-	5.000
Congressional Add Subtotals for Project: 633946	11.830	15.000
Congressional Add Totals for all Projects	11.830	15.000

Change Summary Explanation

Increase in FY13 Congressional Adds for enhanced efforts in materials research and technology.

Decrease in FY13 Other Adjustments was due to Sequestration.

Increase in FY14 Congressional Adds for enhanced efforts in (a) materials research and technology and (b) metals affordability.

Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*	Project (Number/Name) 632100 / *Laser Hardened Materials*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
632100: *Laser Hardened Materials*	-	18.643	20.450	17.285	-	17.285	15.934	17.381	17.127	17.496	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Aerospace Systems Protection	9.596	10.800	8.161

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

FY 2013 Accomplishments:

Demonstrated viable coating and hardened focal planes for future persistent surveillance sensor designs. Demonstrated strategies to mitigate directed energy damage for visual/near-infrared (NIR), short wave infrared (SWIR), and mid wave infrared (MWIR) detectors critical to Intelligence, Surveillance and Reconnaissance (ISR) sensors. Demonstrated damage-limiting semiconductor materials in a test bed configuration representing protection of both visual/NIR and SWIR ISR sensors. Employed 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:

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 visual/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.

FY 2015 Plans:

Continue development of protection materials for visual/NIR ISR Sensors. Demonstrate use of protection technologies for future ISR sensor designs and strategies to mitigate directed energy damage for visual/NIR, SWIR, and MWIR detectors. Develop survivable electro-optic sensors that provide full spectrum protection for missile warning. Continue evaluating the

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 632100 / *Laser Hardened Materials*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
performance impact of damage-limiting semiconductor materials designed to harden electro-optic imaging sensors. Develop laser countermeasures for survivability of dynamic electro-optional and infrared (EO/IR) imagers. 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 2013 Accomplishments:*** Developed and demonstrated personnel protection technologies for daytime operation across the visible/NIR and SWIR spectral bands. Fabricated and demonstrated performance of agile optical coatings and dyes for use in daytime visor configurations. Characterized eye protection technologies using computational materials science tools. Insured 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. ***FY 2015 Plans:*** Develop and demonstrate laser protection materials and technologies for personnel protection. Continue development of helmet mounted sensor hardening materials. Continue development of visor based aircrew protection materials. Characterize eye protection technologies using computational materials science tools. Continue to improve functionality and performance of personnel protection technologies in expected operational conditions.	9.047	9.650	9.124
Accomplishments/Planned Programs Subtotals	18.643	20.450	17.285

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not Applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*	Project (Number/Name) 633153 / *Non-Destructive Inspection Development*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633153: *Non-Destructive Inspection Development*	-	7.015	6.766	5.275	-	5.275	5.558	6.601	6.383	6.478	Continuing	Continuing

The FY 2015 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 technologies to monitor performance integrity and to detect failure causing conditions in weapon systems components and materials. Nondestructive inspection/evaluation 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 2013	FY 2014	FY 2015
Title: Advanced Engine Inspection Technologies	1.474	1.300	1.298
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 2013 Accomplishments: Initiated development of novel, whole-field nondestructive inspection/evaluation approaches to nondestructively assess material and damage state of critical turbine engine components for the purpose of extending the useful life without increasing risk of in-flight failure of fracture to critical gas turbine engine components.			
FY 2014 Plans: Continue development of nondestructive inspection/evaluation approaches to nondestructively assess material and damage state of critical turbine engine components for the purpose of extending the useful life without increasing risk of in-flight failure of fracture to critical gas turbine engine components.			
FY 2015 Plans: Demonstrate nondestructive inspection/evaluation approaches to nondestructively assess material and damage state of critical turbine engine components for the purpose of extending the useful life without increasing risk of in-flight failure of fracture critical to gas turbine engine components.			
Title: Low-Observable Inspection Technologies	0.541	0.466	0.985
Description: Develop and demonstrate advanced inspection technologies supporting low-observable (LO) systems to enhance affordability and ensure full performance and survivability.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633153 / *Non-Destructive Inspection Development*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Developed and demonstrated a handheld nondestructive inspection tool for signature and material integrity assessment of existing and next generation LO material systems. Developed and demonstrated that the handheld nondestructive inspection tool could identify damage and register position relative to an aircraft, enabling more affordable signature assessment. ***FY 2014 Plans:*** Validate handheld inspection method and sensor system for signature and material integrity assessment of existing and next generation LO material systems. Validate that the handheld nondestructive inspection tool can identify damage and register position relative to an aircraft, enabling more affordable signature assessment. ***FY 2015 Plans:*** Initiate development of improved methods to acquire and analyze data to facilitate improved characterization, registration, and tracking of degradation and damage of LO materials that enables/ensures more affordable 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 2013 Accomplishments:*** Continued development of improved field and depot-level nondestructive inspection/evaluation technologies and methodologies for assessing the structural integrity of airframes. Initiated development of improved nondestructive inspection/evaluation methods to minimize maintenance burden to access critical, hard to reach locations on aircraft structures. Initiated development of technologies to analyze material susceptibility in microbial contamination fuel. Initiated development of technologies to analyze materials state awareness and prevent corrosion. Initiated the integration of computational materials science tools with life prediction methods to enable risk-based life management. ***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. ***FY 2015 Plans:*** Validate and transition improved field and depot-level nondestructive inspection/evaluation technologies and methodologies for assessing the structural integrity of airframes. Validate and transition improved nondestructive inspection/evaluation methods to minimize maintenance burden to access critical, hard to reach locations on aircraft structures. Initiate enhanced methods for collecting and analyzing digital nondestructive inspection/evaluation data necessary for improved damage detection and	5.000	5.000	2.992

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633153 / *Non-Destructive Inspection Development*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
characterization. Validate the integration of computational materials science tools with life prediction methods to enable risk-based life management. Validate and demonstrate technologies to analyze materials state awareness and prevent corrosion. Initiate development of digitally enhanced nondestructive inspection/evaluation techniques.			
Accomplishments/Planned Programs Subtotals	7.015	6.766	5.275

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*	Project (Number/Name) 633946 / *Materials Transition*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633946: *Materials Transition*	-	27.582	27.356	9.617	-	9.617	18.483	15.093	15.309	16.602	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Air Vehicle Materials Technologies	6.990	7.721	8.213
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 2013 Accomplishments:*** Advanced validation of processing methods and lifing tools for graded microstructure turbine engine disk concepts. Validated initial capability of next generation nondestructive inspection/evaluation sensor systems for advanced LO material systems. Initiated development of magnetoresistive sensing technologies. ***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 validation and initiate transition of next generation nondestructive inspection/evaluation sensor systems for advanced LO material systems. Continue to advance development of magnetoresistive sensing technologies. Initiate integration of damage characterization with risk-based life management strategies for turbine engines. Initiate development of materials and processes to increase LO materials affordability. ***FY 2015 Plans:*** Validate and demonstrate processing methods and lifing tools for ceramic matrix composites and graded microstructure turbine engine disk concepts. Demonstrate repeatability of magnetoresistive sensing technologies. Continue integration of damage with risk-based life management strategies for turbine engines. Continue development of materials and processes to increase LO materials affordability.			
Title: High Temperature Material Technologies	2.168	2.635	1.404

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633946 / *Materials Transition*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Advanced multimaterial structure development to optimally address operational temperature zones for hot structure and thermal protection systems. Continued development of 2700F ceramic matrix composites for turbine hot section components. ***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. Continue development of 2700F ceramic matrix composites for turbine hot section components. ***FY 2015 Plans:*** Validate repeatability of 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. Demonstrate 2700F ceramic matrix composites for turbine hot section components.			
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. ***FY 2013 Accomplishments:*** Transitioned production processes and materials to enable an adaptive turbine engine prototype. Performed critical evaluations of technology in the operating environment. ***FY 2014 Plans:*** Complete materials and production process assessments for an adaptive turbine engine prototype. ***FY 2015 Plans:*** Work completed in FY14.	6.594	2.000	-
Accomplishments/Planned Programs Subtotals	15.752	12.356	9.617

	FY 2013	FY 2014
Congressional Add: Materials Research and Technology	11.830	10.000

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603112F / *Advanced Materials for Weapon Systems*	**Project (Number/Name)** 633946 / *Materials Transition*

	FY 2013	FY 2014
FY 2013 Accomplishments: Conducted Congressionally-directed effort. ***FY 2014 Plans:*** Conduct Congressionally-directed effort.		
Congressional Add: Metals Affordability Research ***FY 2014 Plans:*** Conduct Congressionally-directed effort.	-	5.000
Congressional Adds Subtotals	11.830	15.000

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603112F / *Advanced Materials for Weapon Systems*	Project (Number/Name) 634918 / *Deployed Air Base Demonstrations*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634918: *Deployed Air Base Demonstrations*	-	1.094	-	-	-	-	-	-	-	-	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Deployable Airbase Force Protection	1.094	-	-
Description: Demonstrate and transition technologies to provide force protection and fire fighting capability for deployed AEF operations. ***FY 2013 Accomplishments:*** Transitioned current and future work to the Air Force Civil Engineering Center. ***FY 2014 Plans:*** Work completed in FY13.			
Accomplishments/Planned Programs Subtotals	1.094	-	-

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-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603199F / *Sustainment Science and Technology (S&T)*

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
Total Program Element	-	5.833	12.800	15.800	-	15.800	18.500	20.800	23.000	23.414	Continuing	Continuing
635351: *Technology Sustainment*	-	5.833	12.800	15.800	-	15.800	18.500	20.800	23.000	23.414	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project develops and demonstrates mature Air Force Research Laboratory (AFRL) sustainment technologies such as: materials, corrosion, maintenance/ repair techniques, state awareness/non-destructive inspection, health management, life prediction, composite certification and logistics for transition into fielded 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	6.565	12.800	15.800	-	15.800
Current President's Budget	5.833	12.800	15.800	-	15.800
Total Adjustments	-0.732	-	-	-	-
• Congressional General Reductions	-0.009	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.171	-			
• Other Adjustments	-0.552	-	-	-	-

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: System Health Management/Assessment Technologies	1.797	4.425	4.862

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603199F / *Sustainment Science and Technology (S&T)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop, demonstrate, and transition state awareness/system health management technologies. Conduct studies and analyses to design sustainability into future applications. ***FY 2013 Accomplishments:*** Verified 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. Completed validation of eddy current non-destructive inspection (NDI) techniques for KC-135 wing inspection, also applicable to multiple aircraft depot level inspections, which will improve crack detection in multiple layers of material. Initiated 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. Continue health assessment capability development for fielded systems and components. Continue development and demonstration of diagnostic technology to monitor/assess health of airframe/engine and components. Initiate and complete active fuel bladder leak detection capability. Initiate cold work holes analysis to reduce inspections. Complete efforts to detect cracks beneath flush head fasteners and life prediction of wiring insulation. ***FY 2015 Plans:*** Continue development and demonstration of diagnostic technology to monitor/assess health of airframe/engine and components. Continue development of active fuel bladder leak detection capability and health assessment capability development for fielded systems and components. Complete quantification of life extension prediction of A-10 and T-38 aircraft cold worked holes.			
Title: Prevention/Enhanced Maintainability Technologies ***Description:*** Develop, demonstrate, and transition technologies to improve component design, maintenance, replacement, and concepts for performance improvement and reduced maintenance burden. ***FY 2013 Accomplishments:*** Continued 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. Continued residual stress surface treatment approach, enabling a three-fold extension of the A-10 aircraft wing splice life. Continued design, validation and manufacture of aluminum hybrid alternative for A-10 longeron strap replacement to support airframe service life extension. Continued development and demonstration of engine component technologies to enable conversion of MQ-1 Predator engines from aviation gasoline (AVGAS) to Jet Propellant	2.245	5.340	5.592

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603199F / *Sustainment Science and Technology (S&T)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
8 (JP-8). Initiated efforts to develop and demonstrate a life enhancement/repair capability for B-1 access panels and coating thickness measurement technology for the B-2. ***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, 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 development of friction plug welding for a B-1B panel repair, of repair technologies for airfoils and of a solid state amplifier replacement for unsupportable vacuum tubes used on the B-1 aircraft's ALQ-161, defensive avionics system. Complete: Demonstration of conversion of MQ-1 Predator engines from AVGAS to JP-8; ability to reduce icing inhibitor additive to JP-8 without impacting fuel performance; and residual stress surface treatment to extend life of new and repaired A-10 wing splices. ***FY 2015 Plans:*** Continue efforts to demonstrate high reliability of repair and maintenance technologies to increase service time between maintenance actions, including a solid state amplifier replacement for unsupportable vacuum tubes used on the B-1 aircraft's ALQ-161, defensive avionics system. Complete airframe/engine/subsystem technology efforts 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.			
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 and costs, and increase reliability. ***FY 2013 Accomplishments:*** Continued to evaluate technological means to adjust system management and operational sustainment requirements. Initiated 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, reducing costs of additive and maintenance due to fuel tank coat peeling in the B-52 aircraft. Completed validation of 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. Develop and validate a corrosion severity/time model	1.791	3.035	2.846

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603199F / *Sustainment Science and Technology (S&T)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
for hot spots on the C-5 to improve anticipation and management of corrosion damage. Initiate visualizing structural data tool development to assess fleet health and fault detection/arc mitigation for the F-22. Complete effort to reduce icing inhibitor levels in JP-8. ***FY 2015 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.			
Title: Composite Certification ***Description:*** Develop, demonstrate and transition reliability-based design of advanced composites for aircraft structures. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** Demonstrate accurate prediction of the probability of failure and life of bonded and unitized composite structures. Demonstrate manufacturing processes and manufacturing process control of composite primary structures. Demonstrate feasibility of implementing a damage tolerant design approach for composite structures. Demonstrate feasibility and benefits of a robust process for predicting and addressing the risk elements for safe and affordable certification of composite structures. Demonstrate life extension of a composite primary structure beyond that of the original certified service life.	-	-	2.500
Accomplishments/Planned Programs Subtotals	5.833	12.800	15.800

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not Applicable.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603199F / *Sustainment Science and Technology (S&T)*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	32.818	30.546	34.420	-	34.420	39.901	40.058	40.851	39.123	Continuing	Continuing
63665A: *Advanced Aerospace Sensors Technology*	-	14.681	16.632	14.794	-	14.794	20.189	15.677	15.663	15.590	Continuing	Continuing
6369DF: *Target Attack and Recognition Technology*	-	18.137	13.914	19.626	-	19.626	19.712	24.381	25.188	23.533	Continuing	Continuing

The FY 2015 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 area develops and demonstrates advanced technologies for electro-optical sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The second project area 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 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	37.657	30.579	29.808	-	29.808
Current President's Budget	32.818	30.546	34.420	-	34.420
Total Adjustments	-4.839	-0.033	4.612	-	4.612
• Congressional General Reductions	-0.050	-0.033			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.809	-			
• Other Adjustments	-3.980	-	4.612	-	4.612

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*

Increase in FY15 due to increased emphasis in long wave infra-red search truck technology.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*	Project (Number/Name) 63665A / *Advanced Aerospace Sensors Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
63665A: *Advanced Aerospace Sensors Technology*	-	14.681	16.632	14.794	-	14.794	20.189	15.677	15.663	15.590	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project area 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 2013	FY 2014	FY 2015
Title: Integrated Navigation Technologies	1.621	4.483	4.910

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 2013 Accomplishments:
Developed strategies to optimize reference technologies for distributed sensing missions. Maintained/enhanced performance while reducing size, weight, and power. Developed reference optimization components necessary to support bi-static and multi-static radar technologies.

FY 2014 Plans:
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 the Air Force Research Laboratory's Space Vehicles Directorate to develop advanced, low-drift IMUs involving novel measurement techniques.

FY 2015 Plans:
Mature GPS augmentation technologies that take advantage of distributed platforms relaying Global Navigation Satellite Systems (GNSS) signals and geo-referenced real-time imaging to improve GPS accuracy in GPS sparse or denied environments. Develop

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 63665A / *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
technologies that expand the ability to incorporate GNSS signals into GPS user equipment as a means to improve navigation signal reliability and availability.			
Title: Persistent Sensing in Contested Environment Technologies ***Description:*** Develop active radio frequency (RF) sensor solutions to use against difficult-to-detect targets in challenging environments, and advanced RF architectures for open and reconfigurable systems. Enable persistent intelligence, surveillance, and reconnaissance (ISR) over wide areas, and detect advanced air and ground targets. ***FY 2013 Accomplishments:*** Completed development of modular RF backend (demonstration of open systems architecture) for combined radar and signals intelligence (SIGINT) processing and integrated into the outdoor range. Developed and tested a wide area staring radar. ***FY 2014 Plans:*** Complete modular RF backend demonstration for combined radar and signal intelligence (SIGINT). Continue research and development of a wide area staring radar, and begin development of staring radar 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. ***FY 2015 Plans:*** Continue research and development of high performance conformal array antenna technology, novel waveforms, Multiple-Input Multiple-Output (MIMO) signal processing techniques, and cooperative RF sensing from multiple platforms in contested environments. Characterize, measure, model, simulate, and improve system performance of active and passive RF sensing systems in terms of RF sensing geometry, environmental phenomenology, clutter, and interference.	7.104	4.000	3.000
Title: Passive Radio Frequency (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 (ISR) of air and ground targets. ***FY 2013 Accomplishments:*** Completed flight test data collection of passive multistatic radar process data and developed 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	3.675	4.149	3.884

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 63665A / *Advanced Aerospace Sensors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
RF sensing techniques. Conduct research and development of passive RF sensors including phenomenology, modeling and simulation, algorithm development and experimentation. ***FY 2015 Plans:*** Continue research and development of passive multi-mode radar technology, including signal intelligence (SIGINT), airborne moving target indicator (AMTI), ground moving target indicator (GMTI), and synthetic aperture radar (SAR) imaging. Further develop sensor resource management capabilities for sensor time, energy, and waveform management, as well as optimal utilization of non-cooperative signals in the field of regard. Continue development of algorithms and hardware for passive RF sensing applications, with emphasis on both high endurance at long stand-off range, and survivable, covert stand-in RF sensing within contested airspace.			
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 2013 Accomplishments:*** Refined performance and signature models to validated requirements and concept of operations 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. ***FY 2014 Plans:*** Initiate development of advanced active and passive electro-optical (EO) sensing technologies for surveillance and reconnaissance at standoff ranges in contested environments. Continue development of long range temporal synthetic aperture radar 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 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. ***FY 2015 Plans:*** Extend ground moving target indicator (GMTI) and synthetic aperture radar (SAR) techniques developed for detection and tracking of dismounts and high value mobile ground targets from high angle, close-in radio frequency (RF) sensing scenarios to low angle, long stand-off RF sensing geometric scenarios with anti-access/area denial (A2/AD). Revise and extend prior radar systems engineering and develop improved algorithms and multi-static cooperative radar techniques to address the challenges of long stand-off RF sensing in A2/AD airspace.	2.281	4.000	3.000
Accomplishments/Planned Programs Subtotals	14.681	16.632	14.794

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 63665A / *Advanced Aerospace Sensors Technology*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603203F / *Advanced Aerospace Sensors*	Project (Number/Name) 6369DF / *Target Attack and Recognition Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
6369DF: *Target Attack and Recognition Technology*	-	18.137	13.914	19.626	-	19.626	19.712	24.381	25.188	23.533	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project area 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 area 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 area 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 (DARPA) 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 area 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 2013	FY 2014	FY 2015
Title: Automatic Target Recognition	0.516	-	-
Description: Develop and demonstrate an automatic target recognition capability integrated with advanced geo-registration techniques and innovative change detection algorithms.			
FY 2013 Accomplishments: Completed development of enhancements to automatic target recognition, automatic target cueing, geo-registration, and change detection technology to meet warfighter needs. Completed assessment and enhancement of technology supporting time-critical targeting systems in automatic target recognition. Completed 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 data sets as required to support enhanced time-critical targeting capabilities. Completed development and assessment of time-critical targeting and advanced target tracking technologies required to meet warfighter requirements.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 6369DF / *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Effort moved to Wide-Angle,Continuously-Staring Technologies in this Project to better align efforts. ***FY 2015 Plans:*** N/A			
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 2013 Accomplishments:*** Identified 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 Planning, Collection, Processing, Analysis, and Dissemination (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. ***FY 2015 Plans:*** Continue assessing integrated sensor targeting technologies for permissive environments which could serve as candidate solutions for PCPAD in contested environments. Create target signature databases from electro-optical, synthetic aperture radar, and multi-source sensor data for targets representing the highest priority threat systems.	2.881	2.700	3.570
Title: Multi-Sensor Target Recognition ***Description:*** Develop and assess multi-sensor automatic target recognition for intelligence, surveillance, reconnaissance, strike, and weapon systems. ***FY 2013 Accomplishments:*** Initiated technology assessment of intelligence, surveillance and reconnaissance (ISR) systems in anti-access/area denial (A2/AD) environments. Analyzed unique technology requirements for new automatic target recognition fusion algorithms to address anti-access/area denial environments. Initiated research in exploitation algorithms supporting Planning, Collection, Processing, Analysis and Dissemination (PCPAD). Developed fusion algorithm for automatic target recognition and exploitation in non-contested environments. ***FY 2014 Plans:***	6.517	6.484	8.206

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 6369DF / *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Continue development of target signature formation techniques from single and multiple cooperating sensors, and sensors and signals of opportunity. Create experiments for demonstrating the contributions of promising technologies to address deficiencies in automatic target recognition for select classes of targets in contested environments.			
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 2013 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 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. ***FY 2015 Plans:*** Continue development of stand-off (air and space) and episodic stand-in sensing capabilities for contested and denied environments. Continue development of exploitation algorithms, phenomenological modeling, image formation, and target and scenario databases necessary to support transition of staring sensing capabilities to the warfighter. Continue to integrate, demonstrate and evaluate enhanced wide angle and wide area sensing and exploitation technologies in conditions representative of contested and denied environments.	5.225	4.730	7.850
Title: Radio Frequency (RF) Persistent Sensing Technologies	2.998	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603203F / *Advanced Aerospace Sensors*	**Project (Number/Name)** 6369DF / *Target Attack and Recognition Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Completed development of dual-band system, and integrated on to identified platform. ***FY 2014 Plans:*** N/A. This effort completed in FY13. ***FY 2015 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	18.137	13.914	19.626

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603211F / *Aerospace Technology Dev/Demo*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	72.462	77.329	91.062	-	91.062	99.103	61.957	75.937	77.975	Continuing	Continuing
634920: *Flight Vehicle Tech Integration*	-	72.462	77.329	5.665	-	5.665	23.651	15.010	19.910	20.050	Continuing	Continuing
634926: *High Speed/Hypersonic Intgr and Demo*	-	-	-	67.017	-	67.017	51.037	32.557	39.104	38.204	Continuing	Continuing
634927: *Flight Systems Control*	-	-	-	18.380	-	18.380	24.415	14.390	16.923	19.721	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

In FY 2015, this program has two new projects, High Speed/Hypersonic Integration and Demonstration and Flight Systems Control. These projects support Department of Defense (DoD) priorities for demonstrations in hypersonics and unmanned systems, respectively.

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 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 aerospace system upgrades and/or new and future aerospace system developments that have military utility and address warfighter needs.

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	81.376	77.347	82.305	-	82.305
Current President's Budget	72.462	77.329	91.062	-	91.062
Total Adjustments	-8.914	-0.018	8.757	-	8.757
• Congressional General Reductions	-0.107	-0.018			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.101	-			
• Other Adjustments	-6.706	-	8.757	-	8.757

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603211F / *Aerospace Technology Dev/Demo*

Change Summary Explanation

Decrease in FY 2013 Other Adjustments was due to Sequestration.

Increase in FY 2015 due to increase emphasis in hypersonic and autonomous systems control research.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / *Aerospace Technology Dev/ Demo*	Project (Number/Name) 634920 / *Flight Vehicle Tech Integration*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634920: *Flight Vehicle Tech Integration*	-	72.462	77.329	5.665	-	5.665	23.651	15.010	19.910	20.050	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project demonstrates advanced aerospace vehicle technologies. Aerospace Vehicle Technology Integration efforts are accomplished through integration of various technologies to include avionics, advanced propulsion, and weapon systems for demonstration in near-realistic operational environments. Advanced Aerospace Structures Technologies are demonstrated to enhance the capability of current and future aerospace vehicles.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Flight Systems Controls	1.916	3.556	-
Description: Integrates and demonstrates advanced control technologies that improve the performance, reliability, safety, and survivability of manned and unmanned, aerospace systems. Enhanced capabilities are enabled by control, automation, and system level integration of subsystems and systems such as propulsion, airframes, avionics, power, weapons, communications, and operator interfaces. Modeling and simulation, integration, and technology demonstrations in a near-operational environment reduce the risk and time required to transition technologies into existing and future aerospace systems. ***FY 2013 Accomplishments:*** Continued development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Demonstrated cooperative teaming of small unmanned platforms in complex, low altitude environments. Demonstrated autonomous launch and safe airspace interoperability for multiple remotely piloted aircraft (RPA) systems. ***FY 2014 Plans:*** Continue to develop and demonstrate technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Demonstrate airborne control of small unmanned platforms in complex, low altitude environments. Continue demonstration of autonomous and safe airspace interoperability for manned and RPA systems. ***FY 2015 Plans:*** Starting in FY 2015, efforts and funding in this area will be transferred to new project 634927, Flight Systems Control.			
Title: Aerospace Vehicle Technology Integration	54.798	20.952	1.607

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603211F / *Aerospace Technology Dev/ Demo*	**Project (Number/Name)** 634920 / *Flight Vehicle Tech Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: This title changed from Enhanced Platform Capabilities to Aerospace Vehicle Technology Integration to better reflect the content and objectives. Develop, simulate, and demonstrate integrated technologies to improve the performance of aerospace platform capabilities. ***FY 2013 Accomplishments:*** Completed lightweight composite structures ground experiment demonstration. Initiated technology efforts for precision air delivery capability for legacy mobility aircraft by reducing tracking errors and better integration of airdrop technologies. Matured adaptive turbine engine technologies for advanced air vehicles. Continued combined inlet and large bypass ratio fan demonstration. Began demonstration of large cargo aircraft in formation flight for fuel burn reduction to support transition decision. Began 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. ***FY 2015 Plans:*** Initiate C-17 formation flight Advanced Technology Demonstration. Initiate feasibility flight test of C-17 aircraft with aft body drag reduction devices. Continue to improve accuracy, situational awareness, and safety for air drop operations.			
Title: Advanced Aerospace Structure Technologies ***Description:*** This title changed from Multi-Role Structure Technologies to Advanced Aerospace Structure Technologies to better reflect the content and objectives. Develop and demonstrate affordable lightweight, adaptive, and multifunctional structural concepts integrated into aerospace systems. ***FY 2013 Accomplishments:*** Continued flight test of antenna integration into load-bearing structures. Completed demonstrations of key high altitude persistent intelligence, surveillance and reconnaissance (ISR) technologies. Completed demonstration of low band structurally integrated arrays and persistent multi-intelligence platforms. Developed passive flow control improvements for enhanced aero efficiency of legacy aircraft. ***FY 2014 Plans:***	8.835	8.615	4.058

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603211F / *Aerospace Technology Dev/ Demo*	**Project (Number/Name)** 634920 / *Flight Vehicle Tech Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue flight test of directional finding communication antenna integration technology demonstration into load-bearing structures for small remotely piloted aircraft (RPA). Continue flight technology demonstrations of key high altitude persistent ISR for active flutter suppression, gust load alleviation, and adaptive, multi-purpose wing surfaces. ***FY 2015 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.			
Title: Adaptive Structure Technologies ***Description:*** Develop technologies for adaptive structures to provide in-flight modifications offering improved performance. Starting in FY14 this effort moves to thrust Advanced Aerospace Structures Technologies, same Program and Project. ***FY 2013 Accomplishments:*** Completed the development of integrated system health management and adaptive guidance and control technologies for aerospace vehicles. Completed structural health management ground technology demonstration for reusable space access vehicle. ***FY 2014 Plans:*** Starting in FY 2014, efforts and funding in this area will be transferred to Advanced Aerospace Structure Technologies thrust, in this project, to realign and consolidate complimentary efforts. ***FY 2015 Plans:*** N/A	1.058	-	-
Title: High Speed/Hypersonic Vehicle Technologies ***Description:*** This thrust moves to project 634926, High Speed/Hypersonic Integration and Demostration in FY15. Develops, integrates and demonstrates, via simulations, ground, and flight tests, advanced flight vehicle technologies that improve the performance and supportability of future high speed/hypersonic vehicles. System level integration brings together air vehicle technologies along with avionics, propulsion, and warheads and other aerospace subsystems for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational systems. ***FY 2013 Accomplishments:***	5.855	44.206	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603211F / *Aerospace Technology Dev/ Demo*	**Project (Number/Name)** 634920 / *Flight Vehicle Tech Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Completed flight demonstration of technologies applicable to reusable hypersonic vehicles and high-speed weapons and weapon systems. Continued to advance high temperature materials and structures for hypersonic vehicles. Continued 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. ***FY 2015 Plans:*** Starting in FY 2015, efforts and funding in this area will be transferred to new project 634926, High Speed/Hypersonic Integration and Demonstration.			
Accomplishments/Planned Programs Subtotals	72.462	77.329	5.665

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / *Aerospace Technology Dev/ Demo*	Project (Number/Name) 634926 / *High Speed/Hypersonic Intgr and Demo*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634926: *High Speed/Hypersonic Intgr and Demo*	-	-	-	67.017	-	67.017	51.037	32.557	39.104	38.204	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

Note

This is a new project starting in FY 2015 with scope and funding re-aligned from project 634920, Flight Vehicle Technology Integration, to support DoD priorities in hypersonics demonstration. This project integrates advanced technologies such as avionics, propulsion, and other subsystems in simulations, ground tests, and flight tests to validate and demonstrate vehicle performance and other capabilities in environments relevant to or realistically representative of operational missions. These activities and efforts enable low-risk and rapid transition to acquisition programs for near-term weapons systems and development and demonstration of far-term re-usable platforms.

A. Mission Description and Budget Item Justification

This project develops, integrates and demonstrates, via simulations, ground, and flight tests, advanced flight vehicle technologies that improve the performance and supportability of future high speed/hypersonic vehicles. System level integration brings together air vehicle technologies along with avionics, propulsion, and warheads and other aerospace subsystems for demonstration in a near-realistic operational environment. Integration and technology demonstrations reduce the risk and time required to transition technologies into operational systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: High Speed/Hypersonic Vehicle Technologies	-	-	67.017
Description: Develop, simulate and demonstrate integrated vehicle technologies to enable and improve the performance of future high-speed and hypersonic systems. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** Continue 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. Continue advancement of high temperature materials and structures for hypersonic vehicles.			
Accomplishments/Planned Programs Subtotals	-	-	67.017

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603211F / *Aerospace Technology Dev/ Demo*	**Project (Number/Name)** 634926 / *High Speed/Hypersonic Intgr and Demo*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603211F / *Aerospace Technology Dev/ Demo*	Project (Number/Name) 634927 / *Flight Systems Control*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634927: *Flight Systems Control*	-	-	-	18.380	-	18.380	24.415	14.390	16.923	19.721	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

Note

This is a new project starting in FY 2015 with scope and funding re-aligned from project 634920, Flight Vehicle Technology Integration, to support DoD priorities in unmanned systems demonstrations.

A. Mission Description and Budget Item Justification

This program integrates and demonstrates advanced control technologies that improve the performance, reliability, safety, and survivability of existing and future, manned and unmanned, aerospace systems. Enhanced capabilities are enabled by control, automation, and system level integration of subsystems and systems such as propulsion, airframes, avionics, power, weapons, communications, and operator interfaces. Modeling and simulation, integration, and technology demonstrations in a near-operational environment reduce the risk and time required to transition technologies into existing and future aerospace systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Autonomous Systems Control	-	-	18.380
Description: Develop, simulate, and demonstrate advanced automation- and control-enabled capabilities for manned or unmanned aerospace platforms. Develop, simulate, and demonstrate autonomous flight controls for safe flight and cooperative operations between manned and remotely piloted air platforms. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** Further development and demonstration of technologies for situational awareness, autonomous control, and survivability for unmanned systems and manned platforms. Continue demonstration of autonomous and safe airspace interoperability for manned and RPA systems. Continue development and demonstration of airborne control of teams of unmanned aircraft. Continue development and demonstration of improved accuracy, situational awareness, and safety for air drop operations.			
Accomplishments/Planned Programs Subtotals	-	-	18.380

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603211F / *Aerospace Technology Dev/ Demo*	**Project (Number/Name)** 634927 / *Flight Systems Control*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	146.776	159.291	124.236	-	124.236	164.953	109.333	103.450	118.417	Continuing	Continuing
632480: *Aerospace Fuels*	-	3.195	2.452	2.275	-	2.275	4.110	2.280	2.321	4.109	Continuing	Continuing
633035: *Aerospace Power Technology*	-	14.649	17.520	5.417	-	5.417	6.368	11.075	10.016	10.220	Continuing	Continuing
634921: *Aircraft Propulsion Subsystems Int*	-	69.342	64.160	53.675	-	53.675	77.407	19.914	18.051	20.481	Continuing	Continuing
634922: *Space & Missile Rocket Propulsion*	-	20.028	24.061	26.552	-	26.552	34.952	31.160	31.521	37.213	Continuing	Continuing
635098: *Advanced Aerospace Propulsion*	-	8.523	18.811	27.252	-	27.252	23.877	25.212	22.986	20.519	Continuing	Continuing
63681B: *Advanced Turbine Engine Gas Generator*	-	31.039	32.287	9.065	-	9.065	18.239	19.692	18.555	25.875	Continuing	Continuing

The FY 2015 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, rocket, and space 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 Aircraft 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 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	151.152	149.321	141.759	-	141.759
Current President's Budget	146.776	159.291	124.236	-	124.236
Total Adjustments	-4.376	9.970	-17.523	-	-17.523
• Congressional General Reductions	-0.217	-0.030			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	13.000	10.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.638	-			
• Other Adjustments	-13.521	-	-17.523	-	-17.523

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Project: 633035: *Aerospace Power Technology*		
Congressional Add: *Silicon Carbide Research*	11.912	10.000
Congressional Add Subtotals for Project: 633035	11.912	10.000
Congressional Add Totals for all Projects	11.912	10.000

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Increase in FY13 and FY14; Congressional Add for Silicon Carbide research.
Decrease in FY 2015 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 632480 / *Aerospace Fuels*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
632480: *Aerospace Fuels*	-	3.195	2.452	2.275	-	2.275	4.110	2.280	2.321	4.109	Continuing	Continuing

The FY 2015 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 special application fuels, alternate fuels and advanced, novel aerospace propulsion technologies for Air Force applications, including high-speed and 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 2013	FY 2014	FY 2015
Title: Fuel-Related Thermal Management	0.446	0.341	0.416
Description: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.			
FY 2013 Accomplishments: Evaluated fuel-related thermal management requirements of variable-cycle engines.			
FY 2014 Plans: Demonstrate fuel-cooled thermal management approaches for variable-cycle engines.			
FY 2015 Plans: Demonstrate heat sink and coking performance of advanced producible endothermic fuel.			
Title: Gas Turbine Combustion, Emissions, and Performance	0.446	0.341	0.416
Description: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel approaches to assess and reduce soot/ particulate emissions from gas turbine engines.			
FY 2013 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 632480 / *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Supported 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. ***FY 2015 Plans:*** Demonstrate advanced particulate characterization enabling the identification and quantification of particulates absorbed in volatile and non-volatile hydrocarbon fuels.			
Title: Fuel System Technologies ***Description:*** Develop and demonstrate enhancements to fuel system technology. ***FY 2013 Accomplishments:*** Demonstrated effectiveness of Jet Propellant (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. This effort will be completed in FY14. ***FY 2015 Plans:*** N/A	0.446	0.341	-
Title: Fuel Logistics ***Description:*** Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Air Force. ***FY 2013 Accomplishments:*** Demonstrated mitigation of biological growth in alternative fuels and commercial jet fuels in base-level fuel distribution systems. Evaluated the 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. ***FY 2015 Plans:*** Continue to demonstrate and evaluate commerical conversion impacts and fuel filtration devices with nano-size meshes to mitigate biological growth in aviation fuels.	0.714	0.545	0.607
Title: Alternative Jet Fuels	1.143	0.884	0.836

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 632480 / *Aerospace Fuels*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Characterize and demonstrate the use of alternative hydrocarbon jet fuel to comply with Air Force certifications and standards for jet fuels. ***FY 2013 Accomplishments:*** Evaluated storage, distribution, ignition, combustion, and other properties of cellulosic-based alternative aviation fuels produced through thermo-catalytic processes. Initiated support to interagency combustor operability testing. Began publishing research reports for industry review to facilitate development of consistent and common military and commercial fuel specifications. ***FY 2014 Plans:*** Continue to evaluate storage, distribution, ignition, combustion, and other 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. Continue to support interagency combustor operability testing. ***FY 2015 Plans:*** Complete combustor operability study with low-temperature fuel-air ignition and re-light investigation for reference fuels and fuels that are 100% synthetic. Continue to evaluate cellulosic-based alternative aviation fuels produced through fermentation processes.			
Accomplishments/Planned Programs Subtotals	3.195	2.452	2.275

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 633035 / *Aerospace Power Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633035: *Aerospace Power Technology*	-	14.649	17.520	5.417	-	5.417	6.368	11.075	10.016	10.220	Continuing	Continuing

The FY 2015 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 of air platforms. The electrical power system components developed are projected to provide a two-fold 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: High Power Aircraft Subsystem Technologies	2.737	7.520	5.417
Description: Develop components for power generation, conditioning, and distribution; energy storage components; and thermal management components and subsystem technologies for integration into high power aircraft. ***FY 2013 Accomplishments:*** Demonstrated 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 in support of and in preparation for hardware development and demonstration. ***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. Completing design work and initiating component subsystem testing. ***FY 2015 Plans:*** Continue demonstration of platform-level hardware-in-the-loop integrated power and thermal management subsystems. Facilitate technology and hardware development for demonstration of integrated power, thermal and propulsion systems.			
Accomplishments/Planned Programs Subtotals	2.737	7.520	5.417

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 633035 / *Aerospace Power Technology*

	FY 2013	FY 2014
Congressional Add: Silicon Carbide Research	11.912	10.000
FY 2013 Accomplishments: Conducted Congressionally directed effort.		
FY 2014 Plans: Conduct Congressionally directed efforts		
Congressional Adds Subtotals	11.912	10.000

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 634921 / *Aircraft Propulsion Subsystems Int*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634921: *Aircraft Propulsion Subsystems Int*	-	69.342	64.160	53.675	-	53.675	77.407	19.914	18.051	20.481	Continuing	Continuing

The FY 2015 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 (ATEGG) 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-to-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 ten 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 2013	FY 2014	FY 2015
Title: Turbofan/Turbojet Durability	0.500	0.200	-
Description: Design, fabricate, and demonstrate durability and integration technologies for turbofan engines and for turbojet engines to improve durability, supportability, and affordability of Air Force aircraft. ***FY 2013 Accomplishments:*** Investigated inlet and exhaust interactions with initial study effort involving modeling and simulation. ***FY 2014 Plans:*** Complete inlet and exhaust interaction study and demonstrate health monitor technologies. ***FY 2015 Plans:*** N/A.			
Title: Turbofan/Turbojet Performance	6.167	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634921 / *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Design, fabricate, and test advanced component technologies for improved performance and fuel consumption of turbofan and turbojet engines. ***FY 2013 Accomplishments:*** Completed 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. Completed experimental testing of engine technologies. ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** N/A			
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 2013 Accomplishments:*** Completed assembly and instrumentation of supersonic, long endurance turbine engine components. Completed critical technology rig testing and sea level testing of supersonic, long endurance turbine engines. ***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 engine technology applicable to subsonic missiles or unmanned vehicles. Continue detailed design of subsonic small turbine engine technology. Begin preliminary design of subsonic mid-sized turbine engine technology for remotely piloted aircraft. ***FY 2015 Plans:*** Complete rig testing of advanced components for engine technology applicable to missiles and unmanned vehicles. Complete detailed design and begin fabrication and instrumentation of a subsonic small turbine engine technology experimental test. Complete preliminary design of subsonic mid-sized turbine engine technology for remotely piloted aircraft.	15.916	18.428	14.274
Title: Adaptive Turbine Engine Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies.	46.759	45.532	39.401

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634921 / *Aircraft Propulsion Subsystems Int*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Initiated preliminary designs for an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Accelerated engine technology development activity to meet follow on activity need date. Performed augmentor and exhaust nozzle cold flow testing. Performed preliminary design of an advanced adaptive fan. Initiated 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, augmentor, and exhaust rig test hardware. Continue engine technology development activity to support component instrumentation and integration into core engine. ***FY 2015 Plans:*** Complete preliminary design reviews and initiate detailed design of an adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate manufacturing of advanced adaptive core engine test hardware. Continue engine technology development activity to support core engine assembly and initial ground testing.			
Accomplishments/Planned Programs Subtotals	69.342	64.160	53.675

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 634922 / *Space & Missile Rocket Propulsion*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634922: *Space & Missile Rocket Propulsion*	-	20.028	24.061	26.552	-	26.552	34.952	31.160	31.521	37.213	Continuing	Continuing

The FY 2015 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 rocket motor boosters and 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 twenty to fifty percent and reduce launch, operations, and support costs by approximately thirty 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 fifty 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. The project efforts are part of the Rocket Propulsion 21 (RP21) program. The project efforts are reviewed by a DoD level steering committee annually for relevance to DoD missions and achievement of technical goals defined by the RP21 program.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Liquid Rocket Propulsion Technologies	17.262	18.277	20.034
Description: Develop liquid rocket propulsion technology for current and future space launch vehicles.			
FY 2013 Accomplishments: Continued development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept applicable to future expendable and reusable launch vehicles. Continued sub-scale preburner and sub-scale turbine component testing to demonstrate hydrocarbon boost technologies. Began thrust chamber sub-scale development. Began full-scale pre-burner component development.			
FY 2014 Plans: Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept applicable to future expendable and reusable launch vehicles. Continue sub-scale preburner and continue sub-scale			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634922 / *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
turbine component testing to demonstrate hydrocarbon boost technologies. Continue thrust chamber sub-scale development. Continue full-scale pre-burner component development. ***FY 2015 Plans:*** Continue development of hydrocarbon engine components for integration and demonstration in an advanced hydrocarbon engine concept applicable to future expendable and reusable launch vehicles. Complete sub-scale preburner and continue sub-scale turbine component testing to demonstrate hydrocarbon boost technologies. Continue thrust chamber sub-scale development. Continue full-scale pre-burner component development and begin fabrication of test article. Continue design of thrust chamber assembly postponed in FY13.			
Title: On-Orbit Propulsion Technologies ***Description:*** Developed solar electric, electric, and monopropellant propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite maneuvering. ***FY 2013 Accomplishments:*** 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 ***FY 2015 Plans:*** N/A	-	-	-
Title: Ballistic Missile Technologies ***Description:*** Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles. ***FY 2013 Accomplishments:*** Developed advanced missile case, insulation, and nozzle technologies. Developed and ground tested subscale components providing validation of modeling and simulation tools. ***FY 2014 Plans:*** Continue to develop advanced missile case, insulation, and nozzle technologies. Continue validation of modeling and simulation tools. Demonstrate prototype. ***FY 2015 Plans:***	1.587	3.419	4.468

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 634922 / *Space & Missile Rocket Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue to develop advanced missile case, insulation, and nozzle technologies. Continue validation of modeling and simulation tools.			
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 2013 Accomplishments:*** Continued 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. Technologies will be integrated and tested in full-scale demonstration in 2014. ***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 development of next generation of sensors used for aging and surveillance. ***FY 2015 Plans:*** Continue development of next generation of sensors used for aging and surveillance. Support transition of previous tools, models, and data management system to user.	1.179	2.365	2.050
Accomplishments/Planned Programs Subtotals	20.028	24.061	26.552

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 635098 / *Advanced Aerospace Propulsion*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635098: *Advanced Aerospace Propulsion*	-	8.523	18.811	27.252	-	27.252	23.877	25.212	22.986	20.519	Continuing	Continuing

The FY 2015 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 up to Mach 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 2013	FY 2014	FY 2015
Title: Scramjet Technologies	8.523	18.811	27.252
Description: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation up to Mach 7.0.			
FY 2013 Accomplishments: Completed fourth flight test of a scramjet engine demonstrator. Analyzed flight test data and completed final report. Continued development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Completed component demonstration of tactically compliant cold start system. Initiated design of flight weight scramjet engine cold start system, fuel system components, and advanced engine control system technologies.			
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.			
FY 2015 Plans: Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and engine controls. Initiate testing of flight weight ground test engine to demonstrate tactically compliant cold start system.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 635098 / *Advanced Aerospace Propulsion*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Complete fabrication of ground test flight weight engine components for High Speed Strike Weapon demonstration and initiate testing.			
Accomplishments/Planned Programs Subtotals	8.523	18.811	27.252

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / *Aerospace Propulsion and Power Technology*	Project (Number/Name) 63681B / *Advanced Turbine Engine Gas Generator*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
63681B: *Advanced Turbine Engine Gas Generator*	-	31.039	32.287	9.065	-	9.065	18.239	19.692	18.555	25.875	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Core Engine Technologies	12.322	11.030	3.095
Description: Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan and for turbojet engines.			
FY 2013 Accomplishments: Evaluated and conducted post demonstration assessment of high temperature capable, durable compressor, combustor, and turbine technologies for adaptive core engines. Completed fabrication of component technologies and 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.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 63681B / *Advanced Turbine Engine Gas Generator*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue testing of a core-centric durability engine technology for demonstration. Based on test data, refine development and fabrication of component technologies for increased reliability, maintainability, and affordability for potential transition to fielded systems. Initiate durability testing of component technologies. ***FY 2015 Plans:*** Complete fabrication of hardware components enabling increased reliability, maintainability, and affordability for potential follow-on ground engine demonstration or potential acquisition program for transition to fielded systems.			
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 and for turboshaft engines. ***FY 2013 Accomplishments:*** Initiated 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. ***FY 2014 Plans:*** Continue 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. ***FY 2015 Plans:*** Initiate risk reduction rig tests of components 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.	3.500	1.200	0.337
Title: Adaptive Turbine Engine Core Technologies ***Description:*** Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine core technologies. ***FY 2013 Accomplishments:*** Conducted design of core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Performed power and thermal management system analysis and assessment. ***FY 2014 Plans:***	15.217	20.057	5.633

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603216F / *Aerospace Propulsion and Power Technology*	**Project (Number/Name)** 63681B / *Advanced Turbine Engine Gas Generator*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Complete detailed design of core technologies for application to adaptive turbine engine with reduced specific fuel consumption, improved thrust-to-weight, and reduced cost. Initiate hardware procurement and manufacturing of components for transition to experimental core demonstration. Initiate instrumentation and assembly of hardware for transition to experimental core demonstration.			
Accomplishments/Planned Programs Subtotals	31.039	32.287	9.065

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	24.181	43.381	47.602	-	47.602	49.502	54.679	56.314	57.059	Continuing	Continuing
632432: *Defensive System Fusion Technology*	-	1.425	-	-	-	-	-	-	-	-	Continuing	Continuing
633720: *EW Quick Reaction Capabilities*	-	6.828	25.083	28.725	-	28.725	29.510	33.813	35.936	36.795	Continuing	Continuing
63431G: *RF Warning & Countermeasures Tech*	-	11.464	14.410	14.516	-	14.516	15.905	15.795	15.411	15.366	Continuing	Continuing
63691X: *EO/IR Warning & Countermeasures Tech*	-	4.464	3.888	4.361	-	4.361	4.087	5.071	4.967	4.898	Continuing	Continuing

The FY 2015 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 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 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*		**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*			
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	32.941	49.128	37.016	-	37.016
Current President's Budget	24.181	43.381	47.602	-	47.602
Total Adjustments	-8.760	-5.747	10.586	-	10.586
• Congressional General Reductions	-0.036	-0.047			
• Congressional Directed Reductions	-6.000	-5.700			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.509	-			
• Other Adjustments	-2.215	-	10.586	-	10.586

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.

Decrease in FY13 Congressional Directed Reductions related to "Protection concepts for 6th generation aircraft" and "Rapidly fieldable operational demonstrations."

Decrease in FY14 Congressional Directed Reductions related to "Delayed program start."

Increase in FY15 is due to increased emphasis on technology to detect and defeat emerging air threats.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*				Project (Number/Name) 632432 / *Defensive System Fusion Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
632432: *Defensive System Fusion Technology*	-	1.425	-	-	-	-	-	-	-	-	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Integrated Electronic Warfare Technologies	1.425	-	-
Description: Develop affordable radio-frequency and electro-optical emitter warning and electronic warfare (EW) battle management technologies, integrating EW and information operations. ***FY 2013 Accomplishments:*** Developed Distributed Electronic Attack concepts for specific threats and radar classes. ***FY 2014 Plans:*** This effort moves to project 63431G in this program to better align efforts. ***FY 2015 Plans:*** N/A.			
Accomplishments/Planned Programs Subtotals	1.425	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 632432 / *Defensive System Fusion 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*	Project (Number/Name) 633720 / *EW Quick Reaction Capabilities*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633720: *EW Quick Reaction Capabilities*	-	6.828	25.083	28.725	-	28.725	29.510	33.813	35.936	36.795	Continuing	Continuing

The FY 2015 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 electronic warfare (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 2013	FY 2014	FY 2015
Title: Disruptive Electronic Warfare (EW) and Countermeasure Technologies	5.334	11.683	13.550
Description: Develop disruptive EW and countermeasure concepts specifically selected for rapidly fieldable, high-impact effects and demonstrate them in an operational environment. ***FY 2013 Accomplishments:*** Initiated development of disruptive EW and countermeasure concepts and technologies initially identified for high-impact, game-changing effects in a contested electromagnetic spectrum (EMS) environment, and began 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. ***FY 2015 Plans:*** Focus research on investigating the use of directed energy and cyber effects for EW use against Radio Frequency (RF) threats. Determine trade space and conduct experiments of these disruptive technologies against integrated air defense systems and other RF threats. Explore multi-spectral approaches to defense against these threat systems.			
Title: Threat-to-Countermeasure System of Systems (SoS) Methods	1.000	5.800	7.020

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 633720 / *EW Quick Reaction Capabilities*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Establish and maintain an all-source, physics-based, design-level, red-blue, comparative, threat-to-countermeasure SoS techniques methodology. This systems engineering-based electronic warfare (EW) approach will inform programmatic planning, quantify desirable research areas with realistic SoS metrics, and foster improved understanding of future concept contributions to EW warfighting capabilities. ***FY 2013 Accomplishments:*** Initiated 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. ***FY 2015 Plans:*** Improve in-house system of systems analysis capabilities in order to develop new techniques to address multi-spectral EW threats. Conduct initial systems engineering research on new technology initiatives in order to provide physics based, metric-driven projects that will address threats to countermeasure systems.			
Title: Evaluation of Advanced Countermeasure Concepts ***Description:*** Develop a core analytic function, supported by simulation-based wargaming and engineering modeling capabilities for evaluation, development, and demonstration of advanced electronic warfare (EW), cyber, directed energy (DE) and integrated/ systemic, non-kinetic concepts to include special capability programs. ***FY 2013 Accomplishments:*** Initiated development of a core analytic function, supported by 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 simulation based war gaming and engineering modeling capabilities for evaluation, development, and demonstration of advanced countermeasure concepts to include special capability	0.494	7.600	8.155

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 633720 / *EW Quick Reaction Capabilities*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
programs. Expand evaluation capabilities to incorporate full systemic electromagnetic spectrum (EMS) effects and netted/ distributed EW capabilities in anti-access/area denial (A2/AD) scenarios. ***FY 2015 Plans:*** Enhance in-house analysis and assessment capability to include current threat arrays and allow the analysis of distributed EW techniques against these systems. These include hardware in the loop (HWIL) and software in the loop (SWIL) enhancements for EW, electro-optical (EO) / infrared (IR) countermeasures, avionics vulnerability, and positioning, navigation, and timing (PNT).			
Accomplishments/Planned Programs Subtotals	6.828	25.083	28.725

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*	Project (Number/Name) 63431G / *RF Warning & Countermeasures Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
63431G: *RF Warning & Countermeasures Tech*	-	11.464	14.410	14.516	-	14.516	15.905	15.795	15.411	15.366	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Electronic Attack	11.464	14.410	14.516
Description: Develop aerospace platform jamming technologies and techniques to counter advanced radio-frequency (RF) threats associated with current and future aerospace weapon systems. ***FY 2013 Accomplishments:*** Demonstrated adaptable electronic attack (EA) technique concepts against a modeled threat environment. Developed and demonstrated a cognitive jammer system concept in a laboratory environment. Assessed and analyzed proactive electronic protection (EP) concepts. Conducted effort to focus on next generation RF threats and potential electronic warfare (EW) concepts. ***FY 2014 Plans:*** 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. ***FY 2015 Plans:*** Develop and conduct laboratory simulation experiments of adaptable electronic attack (EA) technique concepts. Develop software prototype algorithms for cognitive jammer system concepts as well as protection of avionics systems to cyber-attacks. Continue to develop and demonstrate in laboratory environment advanced EP concepts to defeat next generation RF threats with a major emphasis on penetrating contested, anti-access/area denial scenarios.			
Accomplishments/Planned Programs Subtotals	11.464	14.410	14.516

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 63431G / *RF Warning & Countermeasures 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603270F / *Electronic Combat Technology*	Project (Number/Name) 63691X / *EO/IR Warning & Countermeasures Tech*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
63691X: *EO/IR Warning & Countermeasures Tech*	-	4.464	3.888	4.361	-	4.361	4.087	5.071	4.967	4.898	Continuing	Continuing

The FY 2015 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 (EO) / infrared (IR), and laser threats to aerospace platforms. Off-board (decoys and expendables) and on-board countermeasure technologies developed for aircraft self-protection will provide robust, affordable solutions for protection against infrared missiles with autonomous seekers, multi-spectral threats, laser-guided weapons, and EO/IR tracking systems used to direct EO/IR and radar-guided missiles.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Advanced Electro-Optical (EO)/Infrared (IR) Warning and Countermeasure Technologies	4.464	3.888	4.361

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

FY 2013 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. Performed advanced proactive infrared countermeasures (PIRCM) search, detect, and countermeasure research. Developed concepts for protection of postulated future threats to 6th generation aircraft including definition of component and subsystem requirements.

FY 2014 Plans:

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.

FY 2015 Plans:

Develop advanced EO/IR concepts for protection from postulated future threats, including definition of component and subsystem requirements. Concepts will address contested, anti-access/area denial threats. Conduct laboratory experiments

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603270F / *Electronic Combat Technology*	**Project (Number/Name)** 63691X / *EO/IR Warning & Countermeasures Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
of surrogate multi-mode EO/IR sensors, processors, and track algorithms and continue to perform advanced proactive infrared countermeasure (PIRCM) search, detect, and countermeasure research.			
Accomplishments/Planned Programs Subtotals	4.464	3.888	4.361

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	57.612	67.894	69.026	-	69.026	60.110	66.427	64.627	64.336	Continuing	Continuing
632181: *Spacecraft Payloads*	-	15.194	16.458	12.685	-	12.685	17.333	18.164	16.113	13.202	Continuing	Continuing
633834: *Integrated Space Technology Demonstrations*	-	10.416	11.789	18.378	-	18.378	17.838	20.737	22.463	22.336	Continuing	Continuing
634400: *Space Systems Protection*	-	5.142	5.591	3.881	-	3.881	3.657	4.654	4.723	4.741	Continuing	Continuing
634950: *Space Demonstration*	-	14.223	14.968	11.757	-	11.757	-	-	-	-	Continuing	Continuing
635021: *Space Systems Survivability*	-	3.689	3.344	3.081	-	3.081	2.805	4.469	3.878	4.853	Continuing	Continuing
635083: *Ballistic Missiles Technology*	-	3.320	5.467	7.747	-	7.747	9.708	9.880	9.344	9.433	Continuing	Continuing
63682J: *Spacecraft Vehicles*	-	5.628	10.277	11.497	-	11.497	8.769	8.523	8.106	9.771	Continuing	Continuing

The FY 2015 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 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	64.557	68.071	69.975	-	69.975
Current President's Budget	57.612	67.894	69.026	-	69.026
Total Adjustments	-6.945	-0.177	-0.949	-	-0.949
• Congressional General Reductions	-0.086	-0.177			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.441	-			
• Other Adjustments	-5.418	-	-0.949	-	-0.949

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 632181 / *Spacecraft Payloads*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
632181: *Spacecraft Payloads*	-	15.194	16.458	12.685	-	12.685	17.333	18.164	16.113	13.202	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Advanced Space Electronics	6.657	5.284	4.351
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 2013 Accomplishments:*** Developed multiprocessor components to increase on-orbit processing capability. Developed high-density volatile and non-volatile memory for increased on-orbit storage capability. Completed 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. ***FY 2015 Plans:*** Continue development of multi-processor components to provide extremely-high-performance, low-power on-orbit processing capability. Continue to develop high-density volatile memory devices. Continue structured application specific circuits development to include development of reconfigurable or structured analog array integrated circuits to meet growing need for mixed-signal space electronics.			
Title: Spacecraft Design Tools	2.168	0.998	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop satellite system technologies for spacecraft operations and for satellite control, precision navigation, formation flying, and proximity operations technologies. ***FY 2013 Accomplishments:*** Developed second-generation plug-and-play ground testbed to fully test and demonstrate end-to-end flight ready spacecraft plug-and-play software and hardware. Supported transition of spacecraft modular component technology to large spacecraft. Assisted space acquisitions with modular space component technology assessment. Supported Air Force development of a modular component-based space vehicle. ***FY 2014 Plans:*** Complete development, refinement and use of modular space component ground testbed. Mature plug-and-play standards and structure. Finish supporting Air Force development of a plug-and-play based space vehicle. ***FY 2015 Plans:*** Effort completed in FY 2014.			
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 2013 Accomplishments:*** Validated the guidance, navigation, and control aspects of the autonomous flight software using the mission simulator flight software. Provided engineering to engagement level models for systems engineering and trades, mission planning, and utility analysis to flight experiments and research areas. ***FY 2014 Plans:*** 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. ***FY 2015 Plans:*** Update modeling and simulation tools for flight programs using data sets from recent missions. Continue evaluating the military and technical utility of emerging space vehicle technologies and associated software algorithms.	2.882	2.858	0.899
Title: Advanced Space Sensors	3.487	3.326	2.596

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop space infrared technology and hardened focal plane detector arrays to enable acquisition, tracking, and discrimination of hot targets, as well as "cold body" objects. ***FY 2013 Accomplishments:*** Developed large focal plane array for exquisite imaging for adaptive, comprehensive Space Situational Awareness (SSA). Developed 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. ***FY 2015 Plans:*** Investigate material system alternative to mercury cadmium telluride for use in wide field of view applications in support of classic intelligence, surveillance, and reconnaissance missile warning applications. Continue to mature radiation hardened visible starrers and/or scanners as well as long wavelength infrared detection in support of SSA missions.			
Title: Positioning, Navigation, and Timing (PNT) Space Payload Technologies ***Description:*** Develop, validate, and transition technologies that: enable new, or enhance existing, U.S. PNT satellite capabilities by increasing resiliency and availability of accuracy; and/or increase the affordability of providing current capabilities. Develop validate, and transition technologies to meet identified Air Force Space Command/Space and Missile Systems Center PNT space payload technology needs. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** Initiate acquisition of advanced on-orbit reprogrammable digital waveform generator technology for application to future satellites in the Global Positioning System (GPS) system to enable after-launch modification of the GPS signals or the implementation of new signals and signal combining/synthesis techniques over the on-orbit life of the satellite. Enable increased flexibility and resiliency of the GPS system. Conduct system engineering and initiate designs of advanced technology space qualifiable L-band radio frequency (RF) amplifier(s) for PNT/GPS. ***FY 2015 Plans:***	-	3.992	4.839

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 632181 / *Spacecraft Payloads*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Finalize design and begin performance evaluation of advanced technology space qualifiable L-band RF amplifier(s) for PNT/GPS. Begin system engineering tasks and initiate designs of on-orbit reprogrammable digital waveform generator.			
Accomplishments/Planned Programs Subtotals	15.194	16.458	12.685

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 633834 / *Integrated Space Technology Demonstrations*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633834: *Integrated Space Technology Demonstrations*	-	10.416	11.789	18.378	-	18.378	17.838	20.737	22.463	22.336	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Integrated Satellite Demonstrations	10.416	11.789	18.378
Description: Develop satellite technologies for integrated, robust, flexible, satellite demonstrations building on previous work and leveraging investments by other organizations. ***FY 2013 Accomplishments:*** Completed satellite integration to the launch vehicle. Completed 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. Designed 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 (ESPA) geosynchronous orbit experiment. ***FY 2015 Plans:*** Continue one year of experimental flight operations. Begin analyzing science and health and status data. Verify maneuverable geosynchronous experimental platform design. Verify spacecraft subsystem and payload hardware and software after component/subsystem delivery. Prepare for component/subsystem tests.			
Accomplishments/Planned Programs Subtotals	10.416	11.789	18.378

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 633834 / *Integrated Space Technology Demonstrations*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 634400 / *Space Systems Protection*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634400: *Space Systems Protection*	-	5.142	5.591	3.881	-	3.881	3.657	4.654	4.723	4.741	Continuing	Continuing

The FY 2015 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 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 2013	FY 2014	FY 2015
Title: Space Situational Awareness Capability Development	1.467	2.501	2.690
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 2013 Accomplishments:*** Used results from deep-space imaging experiments to develop a brass board system traceable to a potential space-based capability. Repeated developmental performance tests on brass board hardware and software to verify expected performance. Conducted 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. ***FY 2015 Plans:*** Initiate hardware development on space-based imaging concepts that show viability under the feasibility study. Complete data analysis from the joint threat scenario study to quantify technology return-on-investment metrics. Initiate concept development, modeling, and simulations.			
Title: Space Indicators and Warning Research	2.166	2.745	0.296
Description: Develop passive satellite countermeasures and mitigation techniques for current and future threats to satellites. ***FY 2013 Accomplishments:***			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 634400 / *Space Systems Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Initiated local area sensor for indication and warnings engineering unit development. Designed concept for integrated sensor suite and response system for automated response options. Identified 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. ***FY 2015 Plans:*** Continue updating sensor specifications and evaluating additional sensors to compare attributes (size, weight, power, performance, maturity, etc.) of sensor technologies against case uses/scenarios/missions.			
Title: Spacecraft Threat Detection ***Description:*** Develop active satellite local space awareness technologies and exploitation tools for satellite systems. ***FY 2013 Accomplishments:*** Demonstrated a modular satellite autonomy flight architecture with responsive action to a selected directed energy threat to a hypothetical friendly satellite. This included 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. ***FY 2015 Plans:*** Develop components to enable on-board detection, assessment, and resolution of spacecraft anomalies to include co-orbital and directed energy threats. Employ system levels concepts to enable cross queuing of assets both on-orbit and on the ground.	1.220	0.345	0.895
Title: Satellite RF Characterization ***Description:*** Develop RF characterization methods and performance analysis technology. ***FY 2013 Accomplishments:*** Developed engineering model sensor sub-systems for active and/or passive threat detection and tracking capabilities. Initiated technology risk reduction for U.S. satellite vulnerability mitigation. ***FY 2014 Plans:***	0.289	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 634400 / *Space Systems Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
This thrust has been combined with the Space Indicators and Warning Research thrust in the same project in order to better align counterspace science and technology efforts. ***FY 2015 Plans:*** N/A			
Accomplishments/Planned Programs Subtotals	5.142	5.591	3.881

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 634950 / *Space Demonstration*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
634950: *Space Demonstration*	-	14.223	14.968	11.757	-	11.757	-	-	-	-	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: S&T Space Launch Integration and Test	14.223	14.968	11.757
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 2013 Accomplishments:*** Provided mission definition, design, development, and operations planning. Selected and refined satellite and payload manifest. Initiated 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. ***FY 2015 Plans:*** Finalize satellite and payload manifest. Complete payload/satellite/launch vehicle integration.			
Accomplishments/Planned Programs Subtotals	14.223	14.968	11.757

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
• 0: *N/A*	-	-	-	-	-	-	-	-	-	-	-

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 635021 / *Space Systems Survivability*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635021: *Space Systems Survivability*	-	3.689	3.344	3.081	-	3.081	2.805	4.469	3.878	4.853	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Spacecraft Survivability/Reliability	3.689	3.344	3.081
Description: Develop technologies to provide improved space radiation and ionospheric hazard specification and forecasting. ***FY 2013 Accomplishments:*** Improved software tools to model surface and deep charging, radiation dose rate to spacecraft in real-time for evaluation of spacecraft anomalies. Developed an engineering model of an improved instrument to measure high-energy electrons and protons that contribute to radiation dose and spacecraft charging. 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. ***FY 2015 Plans:*** Expand initial capabilities to new orbital and frequency domains, and incorporate improved data and modeling. Continue developing models of spacecraft material aging and implement into spacecraft charging design tool. Continue exploitation of on-orbit data to improve understanding of system-specific space environment effects. Continue support to next-generation upgrades to the Air Force solar optical and radio-frequency monitoring networks, with emphasis on specification and forecast of solar radio-frequency interference affecting Air Force communications and satellite systems.			
Accomplishments/Planned Programs Subtotals	3.689	3.344	3.081

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 635083 / *Ballistic Missiles Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635083: *Ballistic Missiles Technology*	-	3.320	5.467	7.747	-	7.747	9.708	9.880	9.344	9.433	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Advanced Navigation Instruments	3.320	5.467	7.747
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 2013 Accomplishments:*** Improved Advanced Inertial Measurement Unit (AIMU) design based on engineering model testing. Initiated engineering model build of AIMU for validation of performance in a sled test. Initiated preliminary design for hardening of AIMU to weapons level radiation hardness. Initiated 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 component testing and sled test of prototype AIMU to validate performance. ***FY 2015 Plans:*** Continue weapons hardening of critical technology elements of AIMU system. Build two ground test units with improved design updates for additional testing and integration planning. Investigate and implement multipath mitigation improvements. Incorporate in militarily relevant hardware and conduct field testing.			
Accomplishments/Planned Programs Subtotals	3.320	5.467	7.747

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 635083 / *Ballistic Missiles 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603401F / *Advanced Spacecraft Technology*	Project (Number/Name) 63682J / *Spacecraft Vehicles*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
63682J: *Spacecraft Vehicles*	-	5.628	10.277	11.497	-	11.497	8.769	8.523	8.106	9.771	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Space Power Technologies	1.880	1.372	1.708
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 2013 Accomplishments:*** Completed development of efficient 34% inverted metamorphic (IMM) solar cell. Developed 35-37% IMM and quantum-dot enhanced IMM solar cells. Matured 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. ***FY 2015 Plans:*** Continue development of approaches for greater than 35% efficient solar cells. Mature module/blanket technologies for increased reliability and resiliency. Mature flexible array technologies.			
Title: Spacecraft Thermal Technologies	0.826	0.982	1.082
Description: Develop technologies for long-life, efficient, low-vibration, lightweight mechanical cryocoolers and integration components for space applications. ***FY 2013 Accomplishments:*** Reduced size, weight, and power requirements, eased integration, and increased 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			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 63682J / *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
improve overall cryocooler design. Expanded computer modeling to cover additional cryocooler components, including the pulse tube, and provided 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. ***FY 2015 Plans:*** Continue computer simulations to optimize performance of different cryogenic coolers in support of payload thermal management systems for very large format focal plane arrays for missile warning capability and for industry. Increase manufacturability of space-borne cryocoolers through the implementation of commercial, terrestrial cryocooler technologies, combined with space-like designs.			
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 2013 Accomplishments:*** Developed capability for providing structural dynamics data on large, deployable apertures for space systems. Developed 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. ***FY 2015 Plans:*** Develop thermal technologies for heat dissipation of high energy density spacecraft electronics. Mature technologies for composite spacecraft deployable structures, solar arrays, electro-optical and radio-frequency apertures, and de-orbit mechanisms. Test structurally-integrated sensing technologies on samples representative of satellite structures.	1.367	1.694	2.145
Title: On-Orbit Satellite Controls ***Description:*** Develop technologies for spacecraft controls and mechanisms for on-orbit applications. ***FY 2013 Accomplishments:***	1.555	0.299	0.524

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 63682J / *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Demonstrated and transitioned Space Situational Awareness (SSA) camera tracking software. Demonstrated momentum control systems (control moment gyroscopes) for small satellites in relevant environment; initiated advanced spacecraft guidance, navigation, and control subsystem hardware development efforts. ***FY 2014 Plans:*** Continue advanced spacecraft guidance, navigation, and control subsystem hardware development efforts. ***FY 2015 Plans:*** Initiate development of advanced low size/weight/power high-precision navigation hardware for geosynchronous SSA missions.			
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 2013 Accomplishments:*** 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. ***FY 2015 Plans:*** Continue incremental development of 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. Support Space and Missile Systems Center Low-Cost User Terminal initiatives.	-	5.930	4.449
Title: Advanced Alternative Navigation Technologies ***Description:*** Develop new atomic clock technologies and transition these technologies to industry for potential application to future positioning, navigation, and timing space considerations. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:***	-	-	1.589

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603401F / *Advanced Spacecraft Technology*	**Project (Number/Name)** 63682J / *Spacecraft Vehicles*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Initiate efforts to transition newly-developed atomic clock technology from laboratory experiments to industry for potential space systems application. Design and begin fabricating engineering models of these clocks to meet DoD positioning and timing requirements.			
Accomplishments/Planned Programs Subtotals	5.628	10.277	11.497

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 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603444F / *Maui Space Surveillance System (MSSS)*

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
Total Program Element	-	26.235	26.299	14.031	-	14.031	12.938	11.773	11.778	12.012	Continuing	Continuing
634868: *Maui Space Surveillance System*	-	26.235	26.299	14.031	-	14.031	12.938	11.773	11.778	12.012	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	29.256	26.299	15.774	-	15.774
Current President's Budget	26.235	26.299	14.031	-	14.031
Total Adjustments	-3.021	-	-1.743	-	-1.743
• Congressional General Reductions	-0.038	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.569	-			
• Other Adjustments	-2.414	-	-1.743	-	-1.743

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Operate and Upgrade Maui Space Surveillance System (MSSS)	18.026	15.944	13.002

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603444F / *Maui Space Surveillance System (MSSS)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Operate and upgrade the MSSS to support development, demonstration, and integration of ground-based optical SSA technologies. ***FY 2013 Accomplishments:*** Maintained MSSS facility and experimental equipment in a mission-ready state. Delivered components for upgraded Laser Guidestar system at MSSS. Began refurbishment of 1.6 meter dome with repaint, new gaskets to prevent leaking and advanced electronics. Operated MSSS facility for development and demonstration of ground based optical SSA capabilities such as characterization and identification of space objects. Developed 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 including completing refurbishment of 1.6 meter dome. Complete delivery and begin installation 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. ***FY 2015 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. Operate MSSS facility for development and demonstration of ground based optical SSA capabilities in conjunction with customer programs and an operational SSA mission. Complete installation and testing of equipment for upgraded Laser Guidestar system at MSSS.			
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 2013 Accomplishments:*** Began development of a dual-use sensor technology for identification of objects in geosynchronous orbit. ***FY 2014 Plans:*** Continue to develop laser detection and ranging transceiver for initial low-power technology demonstration to image objects in geosynchronous orbit. ***FY 2015 Plans:***	8.209	10.355	1.029

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603444F / *Maui Space Surveillance System (MSSS)*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Integrate low power transceiver hardware prior to low power testing to image objects in geosynchronous orbit.			
Accomplishments/Planned Programs Subtotals	26.235	26.299	14.031

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603456F / *Human Effectiveness Advanced Technology Development*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	19.303	20.902	21.788	-	21.788	19.817	22.985	24.106	24.831	Continuing	Continuing
635323: *Directed Energy Bioeffects Parameters*	-	0.882	3.684	3.092	-	3.092	2.886	5.594	6.034	6.321	Continuing	Continuing
635324: *Human Dynamics and Terrain Demonstration*	-	8.335	8.622	8.839	-	8.839	7.197	6.812	6.993	7.128	Continuing	Continuing
635325: *Mission Effective Performance*	-	3.759	2.322	4.461	-	4.461	4.564	5.859	6.681	6.904	Continuing	Continuing
635327: *Warfighter Interfaces*	-	6.327	6.274	5.396	-	5.396	5.170	4.720	4.398	4.478	Continuing	Continuing

The FY 2015 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 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. 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. 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 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*			**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	21.523	20.967	21.520	-	21.520
Current President's Budget	19.303	20.902	21.788	-	21.788
Total Adjustments	-2.220	-0.065	0.268	-	0.268
• Congressional General Reductions	-0.029	-0.065			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.419	-			
• Other Adjustments	-1.772	-	0.268	-	0.268

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / *Human Effectiveness Advanced Technology Development*	Project (Number/Name) 635323 / *Directed Energy Bioeffects Parameters*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635323: *Directed Energy Bioeffects Parameters*	-	0.882	3.684	3.092	-	3.092	2.886	5.594	6.034	6.321	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Optical Radiation Bioeffects	0.700	2.219	1.500
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 2013 Accomplishments: Integrated and tested physics-based modeling techniques for advanced Laser Eye Protection (LEP) technologies in next-generation cockpit scenarios for human systems integration and protection. Integrated laser bioeffects models and collateral effects algorithms into high-fidelity engagement simulations of high-energy laser weapon bioeffects. Matured products which enable safe testing of weapon effects and demonstrator concepts on test and evaluation ranges. Completed benchmarks of collateral hazard prediction algorithms for performance and validation and verification of engagement simulations.			
FY 2014 Plans: 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.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*	**Project (Number/Name)** 635323 / *Directed Energy Bioeffects Parameters*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Begin integration of physiological/behavioral response models into engagement-level simulation capabilities for directed energy weapon threats and concepts. Demonstrate modeling and simulation tools which transition engagement-level simulations to mission and campaign models to evaluate the utility and impact of directed energy systems. Apply these models in the battlespace simulation at tactical levels with contribution of bioeffect human vulnerability models in a DoD standardized format. Continue flight evaluation comparisons of predictive human system integration models to performance and acceptance of military users of these technologies in next-generation aircraft, identifying data gaps and optimizing future acquisitions.			
Title: Radio Frequency Bioeffects ***Description:*** Develop and demonstrate technologies to assess radio frequency (RF) bioeffects and collateral hazards from high power RF directed energy systems. ***FY 2013 Accomplishments:*** Demonstrated 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. ***FY 2015 Plans:*** Validate predictive capability of models against high average power scenarios and begin integration of high peak power models and high average power models into one software suite. Continue 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.	0.182	1.465	1.592
Accomplishments/Planned Programs Subtotals	0.882	3.684	3.092

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*	**Project (Number/Name)** 635323 / *Directed Energy Bioeffects Parameters*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / *Human Effectiveness Advanced Technology Development*	Project (Number/Name) 635324 / *Human Dynamics and Terrain Demonstration*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635324: *Human Dynamics and Terrain Demonstration*	-	8.335	8.622	8.839	-	8.839	7.197	6.812	6.993	7.128	Continuing	Continuing

The FY 2015 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 intelligence, surveillance and reconnaissance (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 2013	FY 2014	FY 2015
Title: Human Analyst Augmentation	2.581	3.034	3.419
Description: Develop and demonstrate human-centered design processes and operational tools that optimize ISR information exploitation and analysis. ***FY 2013 Accomplishments:*** Developed an analyst testbed concept for evaluating effectiveness of analyst tool integration in the processing, exploitation, and dissemination process. Developed work aids for intelligence analysts and tools for collaborative synthesis and social cogitive analysis. ***FY 2014 Plans:*** 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. ***FY 2015 Plans:*** Develop analytical work environments and toolsets to create advanced situational performance for ISR work roles that span the processing, exploitation, and dissemination process from time-dominated tactical work situations to content-dominated operational and strategic reach back operations.			
Title: Human Trust and Interaction	2.073	2.394	2.150
Description: Develop/demonstrate technology to optimize human operator performance, adversarial modeling techniques, and automated speech translation tools to aid Air Force information/influence operations.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*	**Project (Number/Name)** 635324 / *Human Dynamics and Terrain Demonstration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Developed 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 intelligence, surveillance, and reconnaissance (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. ***FY 2015 Plans:*** Develop advanced multimedia machine translation and automatic speech recognition tools. Develop 'soft' and 'hard' fusion methodology experiments.			
Title: Human Signatures ***Description:*** Develop automated and assisted methods to exploit human threat biosignatures to defeat terrorist activities and hidden person-borne threats. Provide improved models of virtual humans to deliver mission-ready training for intelligence, surveillance, and reconnaissance (ISR) analysts and create more immersive, realistic experiences in joint and coalition exercises. ***FY 2013 Accomplishments:*** Developed 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. Demonstrated initial libraries in joint virtual training software for human threat recognition and feasibility for integration into future on-board sensor systems. ***FY 2014 Plans:*** 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. ***FY 2015 Plans:*** Demonstrate utility of integrated normative anthropometric-based human signatures data sets. Demonstrate wearable wireless monitors for human performance real-time assessment for multiple operational settings.	3.681	3.194	3.270
Accomplishments/Planned Programs Subtotals	8.335	8.622	8.839

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*	**Project (Number/Name)** 635324 / *Human Dynamics and Terrain Demonstration*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / *Human Effectiveness Advanced Technology Development*	Project (Number/Name) 635325 / *Mission Effective Performance*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635325: *Mission Effective Performance*	-	3.759	2.322	4.461	-	4.461	4.564	5.859	6.681	6.904	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Continuous Learning	3.759	2.322	4.461

Description: Develop and demonstrate secure, persistent, and standardized live, virtual and constructive (LVC) training enterprise. Utilize modeling capabilities for technology demonstration efforts focused on developing software-based tools for training that would replace human instructors. This enables more efficient mission execution training in an LVC environment.

FY 2013 Accomplishments:
Demonstrated learning-managed LVC for fifth generation air combat mission training. Completed evaluation of deployable training solutions across mission sets. Completed evaluation of prototype joint criteria, models, and tools for environmental certification applicable across LVC contexts. Demonstrated and validated standardized process and integrated toolsets for correlated simulation database development across different virtual environments.

FY 2014 Plans:
Complete development, demonstration, and initial transition of learning management system for distributed mission operations (DMO) and LVC operations. Initiate development of standards for shareable scenario content, data, and metrics.

FY 2015 Plans:
Complete performance-based LVC environment fidelity assessment system. Complete development of automated tools to analyze training utility for alternative ways to accomplish mixes of live and virtual training in and across mission sets. Begin development of common scenario, learner performance, and after action review content tagging for training. Develop learning management technologies for undergraduate pilot training. Develop adaptive training and performance measurement system for

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*	**Project (Number/Name)** 635325 / *Mission Effective Performance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
intelligence, surveillance and reconnaissance (ISR) analysts. Develop low-cost, multiple-platform RPA training system. Initiate adaptive training for Red Flag preparation. Develop deployable LVC capability for emergency responders.			
Accomplishments/Planned Programs Subtotals	3.759	2.322	4.461

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603456F / *Human Effectiveness Advanced Technology Development*	Project (Number/Name) 635327 / *Warfighter Interfaces*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635327: *Warfighter Interfaces*	-	6.327	6.274	5.396	-	5.396	5.170	4.720	4.398	4.478	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Applied Neuroscience	1.727	0.800	0.729
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 2013 Accomplishments: Developed neurophysiologic-sensored technology for determining operator workload. Integrated neurophysiologic sensors with automated system adaptation methods, software, and tools. Identified visualization, tool composition, and user interface requirements to support cyber operations. Analyzed human operator team composition and requisite skill sets based upon cyber tool set composition and information flow. Based upon human-computer interface requirements analyses, provided 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.			
FY 2015 Plans: Finalize design recommendations for an integrated offensive and defensive cyber operator tool set. Integrate neurophysiological sensors and validated biofluid sensors capable of real-time assessment of human cognition, human-machine teaming status, and calibrated trust. Conduct cognitive task analyses and cognitive work analyses in operational cyber and other operational domains			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*	**Project (Number/Name)** 635327 / *Warfighter Interfaces*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
to develop technical requirements and make operational recommendations based on findings. Integrate sensors, methodologies, and approaches to assess operator functional state relating to stress, cognition, trust, and human-machine teaming.			
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 2013 Accomplishments:*** Developed 3-D acoustic models of manned and unmanned aircraft for incorporation into high-fidelity acoustic mission planning tools. Collected high-fidelity 3-D acoustic measurements of manned and unmanned aircraft. Determined aural detectability across a wide range of weather conditions, geography, and background sounds. Employed usability engineering methodologies to establish user requirements and use-case scenarios for the pararescue jumper community. Prototyped 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. ***FY 2015 Plans:*** Integrate real-time 3-D acoustic models into mission planning tools. Validate high-fidelity 3-D acoustic models against real-world data obtained from airborne platform measurements in different weather and terrain environments. Validate weather effects, landscape sounds, and geography used in developed acoustic models. Apply human factors and usability engineering methodologies to prototype and test wearable interfaces for seamless integration of data for battlefield airmen.	2.650	3.464	2.901
Title: Human Role in Semiautonomous Systems ***Description:*** Develop and demonstrate an integrated human-centered interface to control multiple remotely piloted aircraft (RPAs) that have various levels of autonomy and that optimize net-centric information flow. ***FY 2013 Accomplishments:*** Validated warfighter requirements for the next-generation operator control station that will accommodate advanced and legacy RPAs. Integrated and tested technologies for operator interface controls, displays, and decision-aids to manage multimission	1.950	2.010	1.766

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603456F / *Human Effectiveness Advanced Technology Development*	**Project (Number/Name)** 635327 / *Warfighter Interfaces*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
RPAs and payloads. Conducted prototype evaluations of operator interface controls. Performed 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. ***FY 2015 Plans:*** Demonstrate and evaluate operator interface designs to support decision-making and situation awareness while controlling multiple advanced and legacy RPAs in a dynamic mission environment. Perform initial evaluations of multitransit control station interface technology to enable a single pilot to simultaneously control multiple RPAs transiting through airspace by using high-fidelity simulations. Using high-fidelity simulations and flight tests, evaluate interfaces for a networked RPA collaborative environment to allow teams of pilot, sensor, and payload operators to work together during various RPA mission phases.			
Accomplishments/Planned Programs Subtotals	6.327	6.274	5.396

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 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603601F / *Conventional Weapons Technology*

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
Total Program Element	-	32.518	33.996	42.046	-	42.046	50.047	48.077	55.459	58.411	Continuing	Continuing
63670A: *Conventional Weapons Development*	-	32.518	33.996	42.046	-	42.046	50.047	48.077	55.459	58.411	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	36.352	33.996	43.589	-	43.589
Current President's Budget	32.518	33.996	42.046	-	42.046
Total Adjustments	-3.834	-	-1.543	-	-1.543
• Congressional General Reductions	-0.048	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.780	-			
• Other Adjustments	-3.006	-	-1.543	-	-1.543

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY 2015 is due to higher DoD priorities.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Ordnance Technologies	16.008	6.500	8.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603601F / *Conventional Weapons Technology*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Develop and demonstrate ordnance technologies to improve conventional, air-delivered munitions. Specific technical areas of focus include fuzes, energetic materials, and warheads. ***FY 2013 Accomplishments:*** Developed technologies for a conventional ordnance package capable of penetrating high performance concrete at velocities up to 2,500 feet per second. Developed and demonstrated technologies to incorporate velocity augmentation for penetrating weapons. Continued developing an ordnance package that enables the warfighter to tailor the weapon effects for the target and its surrounding environment. Investigated alternate fuzing 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. ***FY 2015 Plans:*** Demonstrate alternate fuzing technologies to increase the reliability of penetrating weapons. Develop and assess ordnance technologies that enable high-speed strike weapon concepts through use of reactive composite cases, dual use of propulsion fuels, and focused fragmentation. Complete the development of an ordnance package that enables the warfighter to tailor the weapon effects for the target and its surrounding environment.			
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 2013 Accomplishments:*** Continued to develop technology for precision weapon navigation in GPS-degraded environments. Developed technologies capable of guiding a high-speed strike weapon characterized by very high terminal speed and high end-game maneuverability. ***FY 2014 Plans:*** 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. ***FY 2015 Plans:***	7.005	11.700	7.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603601F / *Conventional Weapons Technology*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue to develop and assess 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 2013 Accomplishments:*** Completed the 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. Continued to refine employment concepts and system technologies for high-speed penetrating weapons with velocity augmentation. Continued the development of a munition concept to incorporate technologies for carriage and terminal impact at high speed. Increased 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. ***FY 2015 Plans:*** Conduct relevant long range strike weapon technology demonstration to reduce risk for a potential follow-on acquisition program. Continue the development of a munition concept to incorporate technologies for carriage and terminal impact at high-speed. Continue investigating concepts for cooperative control of small weapons to produce scalable effects to increase the capacity and capability of fifth-generation aircraft. Demonstrate the ability to articulate the trades and synergies of kinetic energy and directed energy weapons by incorporating higher fidelity methodologies into systems level analysis, including the joint weapons effectiveness analyses. Demonstrate weapon integration concept for air target engagement.	9.505	15.796	27.046
Accomplishments/Planned Programs Subtotals	32.518	33.996	42.046

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603601F / *Conventional Weapons Technology*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603605F / *Advanced Weapons Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	16.994	19.000	23.542	-	23.542	32.295	33.811	38.999	30.493	Continuing	Continuing
633151: *Lasers and Imaging Development and Integration*	-	10.918	9.518	16.011	-	16.011	13.474	12.926	12.087	12.340	Continuing	Continuing
633152: *High Power Microwave Development and Integration*	-	6.076	9.482	7.531	-	7.531	18.821	20.885	26.912	18.153	Continuing	Continuing

The FY 2015 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 (HEL), 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	19.004	19.000	25.374	-	25.374
Current President's Budget	16.994	19.000	23.542	-	23.542
Total Adjustments	-2.010	-	-1.832	-	-1.832
• Congressional General Reductions	-0.025	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.402	-			
• Other Adjustments	-1.583	-	-1.832	-	-1.832

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher DoD priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603605F / *Advanced Weapons Technology*	Project (Number/Name) 633151 / *Lasers and Imaging Development and Integration*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633151: *Lasers and Imaging Development and Integration*	-	10.918	9.518	16.011	-	16.011	13.474	12.926	12.087	12.340	Continuing	Continuing

The FY 2015 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 HEL device 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 2013	FY 2014	FY 2015
Title: High Energy Laser/Beam Control	10.918	9.518	16.011
Description: Develop and demonstrate advanced beam control technologies, integrated laser systems, and aircraft self-protection laser technologies. Demonstrate beam control components integrated with HELs for military utility. ***FY 2013 Accomplishments:*** Continued to build-up and characterize the beam control system, completed the acquisition tracker interface, and completed 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. Investigated subsystem and system level capability concepts that integrate technologies for aircraft self-protection. Developed aero-effects predictive capability for airborne HEL platforms. Tested and characterized a wide-field-of-regard, transonic, tactical laser turret. ***FY 2014 Plans:*** With DARPA, integrate their high energy electric laser device and the Air Force beam control system on level ground and prepare to conduct high energy laser tests against various targets including rockets, artillery, and mortars (RAM). Continue to investigate concepts and technology requirements for future HEL applications such as aircraft self-protection ***FY 2015 Plans:*** With DARPA, conduct high power testing against counter-RAM targets using the integrated high energy electric laser device and beam control system on level ground and prepare to conduct high energy laser tests from a 3000 foot peak against various targets including ground targets and surface-to-air missiles. Document field lethality data, modeling and simulation tools, and lessons learned on the tests. Begin design of a full scale turret with aero-effects mitigation.			
Accomplishments/Planned Programs Subtotals	10.918	9.518	16.011

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603605F / *Advanced Weapons Technology*	**Project (Number/Name)** 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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603605F / *Advanced Weapons Technology*	Project (Number/Name) 633152 / *High Power Microwave Development and Integration*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
633152: *High Power Microwave Development and Integration*	-	6.076	9.482	7.531	-	7.531	18.821	20.885	26.912	18.153	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project develops and demonstrates 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 2013	FY 2014	FY 2015
Title: HPEM Technologies	6.076	9.482	7.531
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 2013 Accomplishments:*** Conducted a very successful flight test of the high power microwave (HPM) payload for the Counter-electronic High Power Microwave Advanced Missile Project. Analyzed the large amount of data from the flight test. Began development and evaluation of 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. ***FY 2015 Plans:*** Begin design of a class of reusable, multi-pulse, multi-target counter-electronics payloads capable of being hosted in various advanced platforms. Characterize, model, test and evaluate Red directed energy threats on Blue assets.			
Accomplishments/Planned Programs Subtotals	6.076	9.482	7.531

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603605F / *Advanced Weapons Technology*	**Project (Number/Name)** 633152 / *High Power Microwave Development and Integration*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603680F / *Manufacturing Technology Program*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	51.448	41.353	42.772	-	42.772	43.164	46.911	45.763	41.045	Continuing	Continuing
635280: *Manufacturing Technologies*	-	51.448	41.353	42.772	-	42.772	43.164	46.911	45.763	41.045	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

The Manufacturing Technology 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. Value stream modifications and manufacturing throughput improvements are effected to shorten cycle times of weapon systems during design, development, production and sustainment. Manufacturing Technologies 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 Science and Technology 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 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	37.045	41.353	41.444	-	41.444
Current President's Budget	51.448	41.353	42.772	-	42.772
Total Adjustments	14.403	-	1.328	-	1.328
• Congressional General Reductions	-0.075	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	20.000	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.816	-			
• Other Adjustments	-4.706	-	1.328	-	1.328

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Project: 635280: *Manufacturing Technologies*		
Congressional Add: *Program Increase*	18.324	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603680F / *Manufacturing Technology Program*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Congressional Add Subtotals for Project: 635280	18.324	-
Congressional Add Totals for all Projects	18.324	-

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.

Increase in FY13 Congressional Adds for advanced manufacturing technologies.

Increase in FY15 due to emphasis on advanced structures material maturation.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Sustainment Manufacturing Technologies	8.798	12.500	11.880
Description: Develop and implement cost-effective maintenance, repair, and manufacturing technologies for sustainment of Air Force weapon systems. ***FY 2013 Accomplishments:*** Developed cost effective conventional and low observable production and repair technologies enabling affordable sustainment of aircraft systems. Conducted assessments and developed manufacturing technology to reduce logistics support costs, lead times for high value supply chain commodities, and cycle times for depot repair. ***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. ***FY 2015 Plans:*** Continue development of cost effective conventional and low-observable production and repair technologies to enable affordable sustainment of aircraft systems. Continue manufacturing technology development for depot maintenance.			
Title: Advanced Manufacturing Technologies	24.326	28.853	30.892
Description: Develop and transition pervasive affordability and producibility technologies for weapon systems and processes. ***FY 2013 Accomplishments:***			

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603680F / *Manufacturing Technology Program*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed and demonstrated rapid response and flexible manufacturing methods, commercial/military integration, quality processing and supply stream improvements. Demonstrated manufacturing capabilities for more affordable low-observable structures, advanced propulsion technologies, electronics and optics manufacturing technologies for Command and Control, Intelligence, Surveillance and Reconnaissance (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. ***FY 2015 Plans:*** Continue development and demonstration of manufacturing capabilities for more affordable advanced turbine engine propulsion technologies, communications technologies, advanced Active Electronically Scanned Array (AESA) sensor applications, and Mid-Wave Infrared optics producibility. Continue development of agile manufacturing applications and hot structures affordability and continue to mature advanced material development.			
Accomplishments/Planned Programs Subtotals	33.124	41.353	42.772

	FY 2013	FY 2014
Congressional Add: Program Increase	18.324	-
FY 2013 Accomplishments: Conducted Congressionally-directed effort.		
Congressional Adds Subtotals	18.324	-

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Air Force	Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603680F / *Manufacturing Technology Program*

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 2015 Air Force											Date: March 2014	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	27.994	49.079	35.315	-	35.315	44.531	50.418	56.540	58.692	Continuing	Continuing
635319: *Anticipatory OPS Intent and Response*	-	4.339	6.176	4.234	-	4.234	4.091	7.185	4.749	6.196	Continuing	Continuing
635320: *Assured Worldwide Connectivity*	-	11.677	21.471	19.412	-	19.412	19.978	24.959	35.025	32.405	Continuing	Continuing
635321: *Global Battlespace Awareness*	-	7.010	14.079	7.957	-	7.957	15.139	8.491	12.845	14.763	Continuing	Continuing
635322: *Knowledge Management and Computing*	-	4.968	7.353	3.712	-	3.712	5.323	9.783	3.921	5.328	Continuing	Continuing

The FY 2015 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 2015 Air Force					Date: March 2014
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*			**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*		
B. Program Change Summary ($ in Millions)	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO**	**FY 2015 Total**
Previous President's Budget	31.419	49.093	39.693	-	39.693
Current President's Budget	27.994	49.079	35.315	-	35.315
Total Adjustments	-3.425	-0.014	-4.378	-	-4.378
• Congressional General Reductions	-0.041	-0.014			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.802	-			
• Other Adjustments	-2.582	-	-4.378	-	-4.378

Change Summary Explanation

Decrease in FY13 Other Adjustments was due to Sequestration.
Decrease in FY15 is due to higher Department of Defense priorities.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635319 / *Anticipatory OPS Intent and Response*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635319: *Anticipatory OPS Intent and Response*	-	4.339	6.176	4.234	-	4.234	4.091	7.185	4.749	6.196	Continuing	Continuing

The FY 2015 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 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 2013	FY 2014	FY 2015
Title: Adaptive Planning and Decision Tools	2.103	2.092	2.656
Description: Develop and demonstrate the integration of planning tools and information-based intelligent agents for adaptive replanning and decision support tools.			
FY 2013 Accomplishments: Developed 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. Initiated 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 Command and Control. 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. Initiate research to demonstrate anticipatory defense of the command and control information infrastructure.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635319 / *Anticipatory OPS Intent and Response*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. Continue research to demonstrate anticipatory defense of the command and control information infrastructure.			
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 2013 Accomplishments:*** Developed 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. 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 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. Accelerate 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). ***FY 2015 Plans:*** Complete 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. Continue 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).	2.236	4.084	1.578
Accomplishments/Planned Programs Subtotals	4.339	6.176	4.234

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635319 / *Anticipatory OPS Intent and Response*

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635320 / *Assured Worldwide Connectivity*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635320: *Assured Worldwide Connectivity*	-	11.677	21.471	19.412	-	19.412	19.978	24.959	35.025	32.405	Continuing	Continuing

The FY 2015 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 2013	FY 2014	FY 2015
Title: Cyber Offense	4.427	5.918	3.570
Description: Develop and demonstrate offensive cyber operations capabilities in a series of experimental technology demonstrations.			
FY 2013 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. Completed analysis of the development of additional offensive cyber operations capabilities, integrated kinetic and cyber operations planning and execution capabilities, and cyber C2 operations functions. Developed and demonstrated capabilities that provide integrated cyber operations.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635320 / *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 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.			
Title: Connectivity Technologies ***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 2013 Accomplishments:*** Completed 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. Conducted an 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 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. ***FY 2015 Plans:*** Continue advanced demonstration of end-to-end QoS and QoA performance for various application-dependent network configuration, management, and implementation scenarios. Continue advanced demonstration of new technologies on an airborne test bed in support of creating an air-air/air-ground secure tactical intranet. Initiate research to demonstrate exploiting of cloud computing and virtualization technologies to provision sufficient computational power for high demand semantic processing of large data sets for mission relevant information dissemination within mission timeline constraints.	1.222	5.634	6.117
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 2013 Accomplishments:***	1.439	1.744	8.088

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635320 / *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Completed 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. Conducted an advanced demonstration of end-to-end QoS and QoA performance for various application-dependent network configuration, management, and implementation scenarios. ***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. ***FY 2015 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. Increase development of techniques for guaranteeing the execution of critical processes during system recovery and data reconstitution. Initiate the development of scientific underpinnings of mission assurance and survivability which links mission awareness data and has dynamic control of information flows with resiliency to maintain levels of assurance.			
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 2013 Accomplishments:*** Developed technologies to implement cyber maneuver capabilities that change the face of the network to confuse the adversaries intelligence gathering attempts thereby not allowing them to find/identify the target system, preventing a future attack. Simulated a diverse set of active machines to thwart an adversary by transferring the attack to specialized nodes for analysis. Developed a capability to automatically generate secure system/network configurations based on policy, architectural specifications, and operational requirements. ***FY 2014 Plans:*** Complete development 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 2015 Plans:***	4.004	7.228	1.637

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635320 / *Assured Worldwide Connectivity*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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 2013 Accomplishments:*** Initiated development of V/W band (50 GHz to 110 GHz) airborne communications components. Initiated 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. ***FY 2015 Plans:*** Effort terminated due to higher Department of Defense priorities.	0.585	0.947	-
Accomplishments/Planned Programs Subtotals	11.677	21.471	19.412

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635321 / *Global Battlespace Awareness*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635321: *Global Battlespace Awareness*	-	7.010	14.079	7.957	-	7.957	15.139	8.491	12.845	14.763	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

The Air Force must be able to process and exploit data and information from a variety of sources and domains to create a common operating picture of the battlespace to allow commanders to maintain information dominance. 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 2013	FY 2014	FY 2015
Title: Advanced Signal and Data Exploitation Technologies	3.137	3.586	1.439
Description: Demonstrate advanced signal and data exploitation technologies for detection, tracking, identification, and targeting of time-critical targets, and information extraction.			
FY 2013 Accomplishments: 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, and the development of novel steganalysis methods for identifying and disrupting embedded information.			
FY 2014 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. Deliver capabilities to increase analyst production by integrating and enhancing multi-intelligence exploitation within the Distributed Common Ground Station (DCGS). Enable semi-automated data-sharing across multiple security enclaves with intelligent data tagging. Provide automated extraction of motion-derived linkages/routes and network relationships.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635321 / *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Deliver activity characterization tools and data mining and fusion capailites that support multiple sources of intelligence (INT) data for cross INT support. 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 DCGS-PED cell operators and NASIC analysts assessment, evaluation, and production activities production by integrating and enhancing multi-intelligence exploitation analytics within the resource-constrained DCGS. Provide automated extraction of motion-derived linkages/routes and network relationships.			
Title: Advanced Data Handling, Visualization and Distributed Data Fusion	2.251	5.367	1.779
Description: Develop and demonstrate advanced data handling, event visualization technologies, and distributed data fusion to enable a more effective utilization of data available. ***FY 2013 Accomplishments:*** Completed development to mature and integrate models for adversarial behavior and provide support for situation analysis utilizing a service oriented architecture. Completed 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. Initiated 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. Continue development of a wide variety of exploitation methods to enhance signals exploitation of modern emerging signals expected from contested environments. Develop real-time audio processing technology to improve the extraction, analysis and reporting of tactical information. Initiate development of learning and inferencing architecture techniques that operate on raw sensor data from heterogeneous sensors in order to determine an automated situational awareness picture. ***FY 2015 Plans:*** Complete development of a prototype for the fusion of information (temporally and geospatially) from multiple exploitation domains to create a comprehensive understanding of the battlespace. Continue development of a wide variety of exploitation methods to enhance signals exploitation of modern emerging signals expected from contested environments. Develop real-time audio processing technology to improve the extraction, analysis, and reporting of tactical information. Continue development of learning and inferencing techniques that operate on raw sensor data from heterogeneous sesnors in order to perform automated multi-			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635321 / *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
domain raw signal fusion. Initiate development of a capability for anticipating adversary courses of actions, situation awareness and automated impact assessment across all mission areas (cyber, space, air).			
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 2013 Accomplishments:*** N/A ***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. ***FY 2015 Plans:*** Continue exploring general purpose bridges between the corpus of electronic text and formal reasoning systems. Complete technologies enabling analysts to efficiently extract/consolidate information from massive amounts of textual data and identify enemy entity-relation. Demonstrate the analysis and visualization of multi-layered networks consisting of diverse data sets with increased accuracy and speed of cross-document entity co-reference and consolidation.	-	1.742	1.294
Title: Adversary Courses of Action ***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 2013 Accomplishments:*** Developed a functional graphical user environment to support output analysis and completed 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. Developed 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. Initiated development of tools to increase awareness of alternatives and ramifications of selecting given target sets. Initiated development of exploitation and analysis tools to automate target recognition and tracking. ***FY 2014 Plans:***	1.622	3.384	3.445

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635321 / *Global Battlespace Awareness*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
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. ***FY 2015 Plans:*** Continue development of a demonstration of advanced analytical capabilities that integrate kinetic and non-kinetic options for full spectrum targeting. Initiate the development of assessment tools that assist the analyst/operator in determining the success/failure of a given target set and/or plan in meeting a stated set of mission objectives. Continue to add targeting capabilities to increase the full range of options available. Enable assessment of kinetic/non-kinetic effects across the targeting process.			
Accomplishments/Planned Programs Subtotals	7.010	14.079	7.957

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 2015 Air Force			Date: March 2014
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603788F / *Battlespace Knowledge Development and Demonstration*	Project (Number/Name) 635322 / *Knowledge Management and Computing*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
635322: *Knowledge Management and Computing*	-	4.968	7.353	3.712	-	3.712	5.323	9.783	3.921	5.328	Continuing	Continuing

The FY 2015 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 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 2013	FY 2014	FY 2015
Title: Game Changing Computing Power	0.717	1.221	1.128
Description: Develop and demonstrate computer architectures with greater capacity and sophistication to enable game changing computing power to the warfighter, anywhere, anytime.			
FY 2013 Accomplishments: Completed the development of petaflops embedded on-demand computing, and demonstrate achieved performance and functionality. Developed architectures for a compact large array of many node clusters with very low power demand for intelligent systems. Developed and demonstrated an autocode generation capability for software intensive systems.			
FY 2014 Plans: Transfered the continued 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 to applied research Dominant Information Sciences and Methods (Program 0602278F), Project 625316. Initiate the design, development, and demonstration of affordable, high-performance, interactive, parallel data exploitation and massively parallel systems.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635322 / *Knowledge Management and Computing*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Continue the design, development and demonstration of affordable, high performance, interactive, parallel data exploitation and massively parallel systems.			
Title: Advanced Information Management ***Description:*** Demonstrate how a publish, subscribe, and query information management (IM) paradigm can enable vertical and horizontal integration of Air Force information systems. ***FY 2013 Accomplishments:*** Developed attack resistant cross domain services. Enabled Voice- Over-IP (VOIP) and video tele-confrence (VTC) content filters for allowing real time domain voice and video communications across coalition partners using cisco video phones. Transitioned filters to Collaboration Gateway Program of Record for C&A with sponsorship from EUCOM for fielding. Developed full cross-domain VTC capability. ***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. ***FY 2015 Plans:*** Demonstrate a suite of new US/coalition collaboration services, producing cross-domain capabilities including voice/video, full motion video (FMV) streaming, automated content inspection, and global trusted remote management. Demonstrate a Secure Cross Domain Video Teleconference capability.	0.426	1.499	1.450
Title: Agile Information Management Services ***Description:*** Demonstrate how agile information management services enable effective information sharing in a tactical environment. ***FY 2013 Accomplishments:*** Completed 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. Designed and developed 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. Investigated and quantified the network burden and QoS requirements for service oriented architecture	3.825	4.633	1.134

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635322 / *Knowledge Management and Computing*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
implementations across a variety of tactical environments. Developed 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. ***FY 2015 Plans:*** Continue investigating and quantifying the network burden and quality of service requirements for service oriented architecture implementations across a variety of tactical environments. Continue design, development and demonstration of mission-oriented, highly adaptive information management technologies. 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. Initiate the development and demonstration of a domain-specific application of high performance, cloud-based, mission relevant information management services. Initiate the development and demonstration of seamless information discovery and delivery through dynamically federated information spaces from forward-deployed tactical networks to reachback to enterprise information assets.			
Accomplishments/Planned Programs Subtotals	4.968	7.353	3.712

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Air Force		Date: March 2014
Appropriation/Budget Activity 3600 / 3	**R-1 Program Element (Number/Name)** PE 0603788F / *Battlespace Knowledge Development and Demonstration*	**Project (Number/Name)** 635322 / *Knowledge Management and Computing*

E. Performance Metrics

Please refer to the Performance Base Budget Overview Book for information on how Air 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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