# DEPARTMENT OF THE AIR FORCE

# FISCAL YEAR (FY) 2008/2009 BUDGET ESTIMATES

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

**DESCRIPTIVE SUMMARIES, VOLUME I** 

# SCIENTIFIC AND TECHNOLOGY BUDGET ACTIVITIES 1-3

**FEBRUARY 2007** 



UNCLASSIFIED

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

### INTRODUCTION AND EXPLANATION OF CONTENTS

### 1. (U) GENERAL

- A. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) program elements and projects in the FY 2008 President's Budget.
  - 1) All exhibits in this document have been assembled in accordance with DoD 7000.14R, Financial Management Regulation, Volume 2B, Chapter 5, Section 050402. Exception:
    - a) Exhibit R-1, RDT&E Program, which was distributed under a separate cover due to classification.
  - 2) Other comments on exhibit contents in this document:
    - a) Exhibits R-2/2a and R-3 provide narrative information for all RDT&E program elements and projects within the USAF FY 2008 RDT&E program with the exception of classified program elements. The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional committees insofar as possible.
    - b) The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.
    - c) There are no "Facilities Exhibits", Military Construction Project Data, (DD 1391), for improvements to and construction of government-owned facilities funded in RD&E, included in this submission.

### 2. (U) CLASSIFICATION

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

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Transformational SATCOM (TSAT)	0603845F	707
University Research Initiatives	0601103F	61
USAF Modeling and Simulation	0207601F	1647
Warfighter Rapid Acquisition Program	0203761F	1377
Wargaming and Simulation Centers	0207605F	1671
Distributed Training and Exercises	0207697F	1677
WEATHER SERVICE	0305111F	1847
Wideband MILSATCOM (Space)	0603854F	749
WWMCCS/GLOBAL COMMAND & CONTROL SYSTEM	0303150F	1779

### DEPARTMENT OF DEFENSE

#### FY 2008 RDT&E PROGRAM

#### SUMMARY (\$ IN THOUSANDS)

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

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22 JAN 2007

#### DEPARTMENT OF DEFENSE

#### FY 2008 RDT&E PROGRAM

#### SUMMARY (\$ IN THOUSANDS)

### 22 JAN 2007

Summary Recap of Budget Activities	FY 2006	FY 2007	FY 2008
Basic Research	374,335	408,547	375,199
Applied Research	1,039,305	1,155,523	1,011,075
Advanced Technology Development	974,770	1,037,521	577,266
Advanced Component Development & Prototypes	2,178,587	2,539,678	2,938,712
System Development & Demonstration	4,592,979	4,671,927	4,319,233
RDT&E Management Support	1,376,255	1,060,430	1,054,328
Operational Systems Development	11,654,712	13,546,997	16,436,127
Total Research, Development, Test & Evaluation	22,190,943	24,420,623	26,711,940
Summary Recap of FYDP Programs			
Strategic Forces	109,692	201,421	136,178
General Purpose Forces	3,352,770	3,949,267	3,666,904
Intelligence and Communications	8,218,167	9,315,800	11,970,886
Mobility Forces	757,616	777,078	1,096,094
Research and Development	9,575,886	9,875,249	9,561,730
Central Supply and Maintenance	127,353	240,089	188,985
Training Medical and Other	3,216	3,467	3,243
Administration and Associated Activities	42,661	54,356	83,879
Support of Other Nations	3,582	3,896	4,041

Total Research, Development, Test & Evaluation22,190,94324,420,623

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26,711,940

#### DEPARTMENT OF THE AIR FORCE

#### FY 2008 RDT&E PROGRAM

#### SUMMARY (\$ IN THOUSANDS)

22 JAN 2007

Summary Recap of Budget Activities	FY 2006	FY 2007		
Basic Research	374,335	408,547	375,199	
Applied Research	1,039,305	1,155,523	1,011,075	
Advanced Technology Development	974,770	1,037,521	577,266	
Advanced Component Development & Prototypes	2,178,587	2,539,678	2,938,712	
System Development & Demonstration	4,592,979	4,671,927	4,319,233	
RDT&E Management Support	1,376,255	1,060,430	1,054,328	
Operational Systems Development	11,654,712	13,546,997	16,436,127	
Total Research, Development, Test & Eval, AF	22,190,943	24,420,623	26,711,940	
Summary Recap of FYDP Programs  Strategic Forces	109,692	201,421	136,178	
Strategic Forces	109,692	201,421	136,178	
General Purpose Forces	3,352,770	3,949,267	3,666,904	
Intelligence and Communications	8,218,167	9,315,800	11,970,886	
Mobility Forces	757,616	777,078	1,096,094	
Research and Development	9,575,886	9,875,249	9,561,730	
Central Supply and Maintenance	127,353	240,089	188,985	
Training Medical and Other	3,216	3,467	3,243	
Administration and Associated Activities	42,661	54,356	83,879	
Support of Other Nations	3,582	3,896	4,041	
Total Research, Development, Test & Eval, AF	22,190,943	24,420,623	26,711,940	

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EXHIBIT R-1

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

### Date: 22 JAN 2007

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

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EXHIBIT R-1

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

### Date: 22 JAN 2007

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

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EXHIBIT R-1

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

Date: 22 JAN 2007

	Program		Thousands of Dollars				
Line No 	Element Number 	Item	Act	FY 2006	FY 2007	FY 2008	Е С -
39	0301556F	Special Program	03				
	Advanced	Technology Development		974,770	1,037,521	577,266	
40	0603260F	Intelligence Advanced Development	04	4,759	4,763	4,930	U
41	0603287F	Physical Security Equipment	04	24,858	1,284	466	U
42	0603421F	NAVSTAR Global Positioning System III	04	89,556	313,401	587,226	U
43	0603430F	Advanced EHF MILSATCOM (SPACE)	04	639,179	630,868	603,179	U
44	0603432F	Polar MILSATCOM (SPACE)	04	6,028	35,470	178,754	U
45	0603438F	Space Control Technology	04	14,598	30,107	37,604	U
46	0603742F	Combat Identification Technology	04	49,569	26,407	26,054	U
47	0603790F	NATO Research and Development	04	3,842	4,080	4,280	U
48	0603791F	International Space Cooperative R&D	04	550	591	619	U
49	0603845F	Transformational SATCOM (TSAT)	04	416,813	729,945	963,585	U
50	0603850F	Integrated Broadcast Service	04	15,930	20,471	21,192	U
51	0603851F	Intercontinental Ballistic Missile	04	56,773	60,907	26,519	U
52	0603854F	Wideband Gapfiller System RDT&E (Space)	04	97,718	37,530	19,213	U
53	0603858F	Space Radar	04	98,062	185,399		U
54	0603859F	Pollution Prevention	04	10,188	7,026	2,838	U
55	0603860F	Joint Precision Approach and Landing Systems	04	6,068	9,908	7,544	U
56	0604015F	Next Generation Bomber	04	24,108	25,491		U
57	0604327F	Hard and Deeply Buried Target Defeat System (HDBTDS) Program	04	3,854			U

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EXHIBIT R-1

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

### Date: 22 JAN 2007

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

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EXHIBIT R-1

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

### Date: 22 JAN 2007

	Program			Tho	usands of Dollars		S
Line No 	Element Number 	Item	Act 	FY 2006	FY 2007	FY 2008	Е С -
77	0604425F	Space Situation Awareness Systems	05		121,696	187,804	U
78	0604429F	Airborne Electronic Attack	05	29,833	12,374	20,007	U
79	0604441F	Space Based Infrared System (SBIRS) High EMD	05	706,560	664,880	587,004	U
80	0604443F	Alternative Infrared Space System (AIRSS)	05		67,552	230,887	U
81	0604600F	Munitions Dispenser Development	05	14,472			U
82	0604602F	Armament/Ordnance Development	05	7,613	5,020	1,985	U
83	0604604F	Submunitions	05	5,368	8,327	1,988	U
84	0604617F	Agile Combat Support	05	11,045	10,056	10,623	U
85	0604618F	Joint Direct Attack Munition	05		15,392		U
86	0604706F	Life Support Systems	05	12,047	14,216	12,649	U
87	0604735F	Combat Training Ranges	05	8,336	16,700	17,657	U
88	0604740F	Integrated Command & Control Applications (IC2A)	05	27,976	23,664	189	U
89	0604750F	Intelligence Equipment	05	2,728	4,907	1,469	U
90	0604762F	Common Low Observables Verification System (CLOVerS)	05	12,737	4,483		U
91	0604800F	Joint Strike Fighter (JSF)	05	2,264,836	2,132,924	1,780,874	U
92	0604851F	Intercontinental Ballistic Missile	05	30,952			U
93	0604853F	Evolved Expendable Launch Vehicle Program (SPACE)	05	19,050	19,738		U
94	0605011F	RDT&E for Aging Aircraft	05	37,404	26,490	17,021	U
95	0605807F	Test and Evaluation Support	05			3,044	U
96	0207434F	Link-16 Support and Sustainment	05	156,851	173,216	199,363	U

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EXHIBIT R-1

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

Date: 22 JAN 2007

	Program			Т	housands of Dollar:	5	S
Line No	Element Number 	Item 	Act	FY 2006	FY 2007	FY 2008	E C
 97	0207443F	Family of Interoperable Operational Pictures (FIOP)	05	35,067			- U
98	0207450F	E-10 Squadrons	05	378,871	366,012	39,703	U
99	0207451F	Single Integrated Air Picture (SIAP)	05		39,973	4,976	U
100	0207701F	Full Combat Mission Training	05	25,723	35,010	87,096	U
101	0305176F	Combat Survivor Evader Locator	05	16,817			U
102	0401138F	Joint Cargo Aircraft (JCA)	05	1,400	15,723	42,368	U
103	0401318F	CV-22	05	33,672	26,501	16,688	U
	System De	evelopment & Demonstration		4,592,979	4,671,927	4,319,233	
104	0604256F	Threat Simulator Development	06	31,387	37,987	39,892	U
105	0604759F	Major T&E Investment	06	62,753	61,671	59,064	U
106	0605101F	RAND Project Air Force	06	33,098	26,510	30,999	U
107	0605306F	Ranch Hand II Epidemiology Study	06	4,024			U
108	0605502F	Small Business Innovation Research	06	339,887			U
109	0605712F	Initial Operational Test & Evaluation	06	28,184	34,670	30,203	U
110	0605807F	Test and Evaluation Support	06	701,064	739,708	737,558	U
111	0605860F	Rocket Systems Launch Program (SPACE)	06	25,365	26,005	15,145	U
112	0605864F	Space Test Program (STP)	06	49,315	46,135	47,430	U
113	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	65,494	55,472	59,131	U
114	0605978F	Facilities Sustainment - Test and Evaluation Support	06	31,697	28,072	30,865	U
115	0804731F	General Skill Training	06	309	304		U

EXHIBIT R-1

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

### Date: 22 JAN 2007

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

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EXHIBIT R-1

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

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

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EXHIBIT R-1

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

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

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EXHIBIT R-1

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

### Date: 22 JAN 2007

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

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EXHIBIT R-1

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

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

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#### DEPARTMENT OF THE AIR FORCE FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

#### Date: 22 JAN 2007

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

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#### DEPARTMENT OF THE AIR FORCE FY 2008 RDT&E PROGRAM

EXHIBIT R-1

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

#### Date: 22 JAN 2007

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

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#### PROGRAM ELEMENT COMPARISON SUMMARY

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

0207434F	Link 16 Support and Sustainment	In FY 2008, Project 655262 was established to consolidate gateway efforts within the Link 16 Support & Sustainment program element. Beginning in FY08, all TDL funding for gateway programs moved from Project 655050 to new Project 655262, Family of Gateways.
0207701F	Full Combat Mission Training	In FY 2008, funding previously documented in BPAC 4673 is consolidated in BPAC 5012
0401138F	Joint Cargo Aircraft	In FY 2008, FY10-FY13: Final AF JCA requirements and procurement quantities are still being defined. These requirements will be validated by early FY08. The AF intends to transfer a portion of APAF funds to RDT&E in the FY10 POM to support any resulting aircraft, training system, test, and support system development requirements that remain.
0604261F	Personnel Recovery Systems	In FY 2008, Project Number 5249, HC-130 Recap, includes new start efforts. Procurement funding for CSAR-X and HC-130 Recap remains in PE 0207224F and is reported in P-Docs.
0604425F	Space Situation Awareness Systems	In FY 2008, this project 65A008 was renamed from Space Situation Awareness Initiatives to its present name.
0604602F	Armament/Ordnance Development	In FY 2008, moved all funds and activities from the other 2 project to project 3133 Armament Subsystems (new name, old name was Bombs & Fuzes). This is done to consolidate and simplify the program element.
0604604F	Submunitions	In FY 2008, for this PE, the T&E funding alignment begins in FY08.
0604617F	Agile Combat Support	In FY 2008, Project 2895, Civil Engineering Readiness (CE), includes two new-start efforts.
0604708F	Civil, Fire, Environmental, Shelter	In FY 2008, the Air Force is in the process of consolidating three small dollar Civil Engineer (CE) readiness R&D programs (PE64617f - Agile Combat Support; PE64708f - Civil, Fire, Environmental, Shelters; and the 3600 portion of PE28031f - War Reserve Material) under PE 64617. This will meet the intent of the House action to eliminate smaller PEs and provide a more cohesive, manageable CE Readiness modernization effort.
0207450F	E-10 Squadrons	In FY 2008, 1 E-10A Testbed Aircraft (Commercial 767-400ER delivered in FY 2008) 1 GH DU radar for radar lab mode checkout and troubleshooting
BUDGET ACTIVITY	#6: RDT&E MANAGEMENT SUPPORT (Volume 2)	
0604759F	Major T&E Investment	In FY 2008, Project 4597, Air Force Test Investments, includes new start efforts
BUDGET ACTIVITY	#7: OPERATIONAL SYSTEM DEVELOPMENT (Volume 3)	
0205219F	MQ-9 Development and Fielding	In FY 2008, This program moved from PE 0305219F.

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

In accordance with the President's Management Agenda, Budget and Performance Integration initiative, these programs have been assessed using the Program Assessment Rating Tool (PART). Remarks regarding program performance and plans for performance improvement can be located at the <u>Expectmore.gov</u> website. The Following are Program Elements not providing RDT&E exhibits due to classification:

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

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### PE NUMBER: 0601102F PE TITLE: Defense Research Sciences

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
	IDGET ACTIVITY     PE NUMBER AND TITLE       Basic Research     0601102F Defense Research Sciences										
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	256.565	281.156	258.259	263.012	321.464	297.882	287.885	306.344	Continuing	TBD
2301	Physics	23.094	27.739	41.282	41.380	49.515	45.169	43.308	45.300	Continuing	TBD
2302	Solid Mechanics and Structures	13.844	17.028	17.029	17.270	19.132	18.334	18.678	19.438	Continuing	TBD
2303	Chemistry	29.574	36.322	32.166	31.480	37.475	35.572	35.950	37.676	Continuing	TBD
2304	Mathematics and Computing Sciences	25.639	31.200	23.283	25.298	31.480	28.121	25.812	26.754	Continuing	TBD
2305	Electronics	29.003	35.400	33.163	33.001	40.215	38.336	38.033	42.449	Continuing	TBD
2306	Materials	37.653	40.150	20.063	20.215	23.148	22.008	22.324	24.384	Continuing	TBD
2307	Fluid Mechanics	15.507	14.017	12.054	12.563	19.602	17.598	15.137	15.662	Continuing	TBD
2308	Propulsion	21.276	21.167	20.272	20.662	22.675	21.751	21.419	24.341	Continuing	TBD
2311	Information Sciences	29.653	26.900	25.412	27.180	36.238	32.413	28.850	29.995	Continuing	TBD
2312	Biological Sciences	9.486	10.014	10.396	10.295	12.153	11.516	12.113	12.927	Continuing	TBD
2313	Human Performance	13.402	12.556	11.120	11.254	16.255	13.945	12.424	12.715	Continuing	TBD
4113	External Research Programs Interface	8.434	8.663	12.019	12.414	13.576	13.119	13.837	14.703	Continuing	TBD

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

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

This program consists of extramural research activities in academia and industry along with in-house investigations performed in the Air Force Research Laboratory. This program funds fundamental broad-based scientific and engineering research in areas critical to Air Force weapon systems. Projects are coordinated through the Defense Reliance process to harmonize efforts, eliminate duplication, and ensure the most effective use of funds across the Department of Defense. All research areas are subject to long-range planning and technical review by both Air Force and tri-Service scientific planning groups. Note: In FY 2007, Congress added \$1M for Fully-Integrated Solar-Powered Interior Lighting Technology, \$1.6M for New Methods for Designing and Testing Aircraft Coatings, \$1M for Smart Surfaces and Interfaces, \$1.7M for NanoPhotonic Components, \$20M for National Aerospace Leadership Initiative, \$2M for National Hypersonics Research Center, \$2.9M for Coal-Based Jet-Fuel, and \$1.8M for Virtual Teleoperations for Unmanned Aerial vehicles. This program is in Budget Activity 1, Basic research, because it funds scientific study and experimentation.

R-1 Line Item No. 1 Page-1 of 60	Exhibit R-2 (PE 0601102F)
1	

Exhibit R-2, RDT&E	Budget Item Justification		DATE Februar	v 2007
BUDGET ACTIVITY 11 Basic Research	PE NUMBER AND TITLE 0601102F Defense Resear	rch Sciences		<u> </u>
U) B. Program Change Summary (\$ in Millions)				
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
U) Previous President's Budget	241.436	250.232	239.586	256.843
U) Current PBR/President's Budget	256.565	281.156	258.259	263.012
U) Total Adjustments	15.129			
U) Congressional Program Reductions		-0.010		
Congressional Rescissions	-0.334	-1.066		
Congressional Increases		12.000		
Reprogrammings	20.955	20.000		
SBIR/STTR Transfer	-5.492			
U) <u>Significant Program Changes:</u> Not Applicable.				
C. Performance Metrics				
(U) Under Development.				
	R-1 Line Item No. 1			
	Page-2 of 60		Exhibit R-2	2 (PE 0601102F)

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY asic Research					IBER AND TITL 02F Defense ces			OJECT NUMBE 01 Physics	R AND TITLE	
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
2201		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2301	Physics	23.094	27.739	41.282	41.380	49.515	45.169	43.308	45.300	Continuing	TBD
Note	Quantity of RDT&E Articles Space environment effort from Project	0	0	0	0	0 04 will be mo	0 wad to this Dro	0	0	uratlay align	hasia
	ch efforts in Physics.	ct 2511 and ph	ysical matteri		om Project 25	04 will be illo	veu to uns ric	ject in FT 20		curatiey angli	Dasic
	A. Mission Description and Budget	Itom Ingthe	4								
H C T	Physics basic research seeks to enable capabilities, communications and navi research investigated by this project and and imaging physics, space environme	e revolutionary igational syste re laser and op	advances in a ms, fuels and a tical physics;	explosives, an electro-energe	d directed ene etics (includes	rgy weapons t	hat are critica	l to the Air Fo	rce. The prim	ary areas of	ors
(U)	B. Accomplishments/Planned Prog	<u>ram (\$ in Mill</u>	<u>ions)</u>				<u>FY 20</u>	<u>06 FY</u>	<u> 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Investigate regul	ated, broad-sp	ectrum, variab	le-energy lase	ers, laser array	s, and	7.8	67	9.535	9.475	9.407
	multi-aperture adaptive optics										
	In FY 2006: Investigated physical pro-	-			-						
	wavelength band lasers. Continued in		• •	-	-	-					
	multi-aperture, adaptive telescopes an	-									
	materials-processing techniques that of packaging capabilities. Continued to e										
	In FY 2007: Further investigate new										
	and widely wavelength tunable lasers		-								
	pumps, as well as other intense light s	-	•	-							
	for direct-write materials processing t			-							
	capabilities. Continue to study semico	-		-	-						
	application to infrared countermeasur	es.									
	In FY 2008: Study mechanical, optic	-	-								
	material and preparation parameters.	-	-			-					
	high beam, quality ceramic lasing. Stu	•	• •	-	-						
	quasi-phase matched semiconductor c	•	-	••••••	•						
• · · · ·	practical limitations on efficiency and	• •	-		ed semiconduc	ctor lasers,					
	which have shown great promise for h In FY 2009: Investigate applications	-			nsive verv hri	oht					
	in 1 2009. Investigate appreations	or provious to	searen enablet	• •	•	-					
Proie	ct 2301				Line Item No. 1 Page-3 of 60					Exhibit R-2a (P	F 0601102F)
. 10]0					3						

	Exhibit R-2a, RDT&E Projec	t Justification		DATI	February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense I Sciences	Research	PROJECT NUM 2301 Physic	/BER AND TITLE	÷
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> micro-plasma array ultraviolet sources to large flexible displays, materials of decontamination, and infectious disease treatment. Continue and expand rese tunable, all solid-state lasers. Study direct-write micro-systems, including on 3-D laser write techniques in special glasses to inexpensive, flexible subsyste	earch on high energy, board power sources. Apply	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Explore high-energy, electro-energetic device concepts molecular properties, atomic collision processes, and atomic, molecular, ion to improve explosives and fuels, advance directed energy systems, enhance a superior communications, and improve precision navigation.	ic, and radiation interactions	10.550	13.466	13.242	13.315
	In FY 2006: Characterized interactions of atoms and molecules in strong ele examined techniques for precision measurement of atomic and molecular pro- processes, and fundamental interactions between atoms, molecules, ions, and dynamic molecular interactions in combustion and high energy density prop- on the stunning effects of short-pulse, high intensity electric fields. Explored device concepts and studies of new compact pulsed power technologies. Exp generated microwave for, high-bandwidth communications, advanced long- electronic countermeasures, and directed energy weapons. Expanded studies generating very high current-density electron beams under high vacuum com of high power microwave weapons concepts. Used atomic physics to study of between atomic physics and condensed matter physics (e.g., the study of ma In FY 2007: Continue characterizing the interactions of atoms and molecular fields. Continue to examine techniques for precision measurement of atomic atomic collision processes, and fundamental interactions between atoms, mo	operties, atomic collision d radiation. Explored ellants. Conducted research high power, high frequency olored use of electron beam distance covert surveillance, of new technologies for ditions for new generations overlap research areas my body phenomena). es in strong electromagnetic and molecular properties, elecules, ions, and radiation. energy density propellants.				
	Continue studies on electro-energetic concepts related to non-lethal weaponn high power, high frequency electromagnetic device concepts and studies of n technologies. Continue to explore the use of electron beam generated microw communications, advanced long-distance covert surveillance, electronic cou energy weapons. Investigate ultra-high current density cathode concepts. Ini simulation of electro-energetic phenomena. Continue study of overlap resear physics and condensed matter physics. Resolve basic scientific issues blocki	new compact pulsed power waves for high-bandwidth ntermeasures, and directed tiate advanced modeling and rch areas between atomic				
Proj	iect 2301	R-1 Line Item No. 1 Page-4 of 60			Exhibit R-2a (l	PE 0601102F)

	Exhibit R-2a, RDT&E Proje	ect Justification		DAT	February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense F Sciences	Research	PROJECT NUI 2301 Physic	BER AND TITLE	
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	electromagnetic launch concepts. In FY 2008: Explore usage of ultra-cold atoms and molecules for precision components and ultra-precise measurement techniques using the results of					
	collision processes and fundamental interactions between atoms, molecule	s, ions, and radiation. Explore				
	the possibility of tailor-making materials using the results of research in the physics and condensed matter physics. Continue exploring new concepts for	-				
	high-frequency electromagnetic radiation sources. Study quantum physics	-				
	emission of electrons from surfaces. Examine the application of Chaos The fundamental limits on electrical energy storage density. Study the seamless	•				
	magnetohydrodynamic and particle-in-cell modeling algorithms to better c	-				
(U)	high power microwave sources. In FY 2009: Continue studying the usage of ultra-cold atoms and molecule	es for precision inertial				
(0)	navigation system components and ultra-precise measurement techniques u	-				
	research into atomic collision processes and fundamental interactions betw					
	and radiation. Continue exploring the possibility of tailor-making materials in the overlap between atomic physics and condensed matter physics. Expl	-				
	methodologies for the realization of compact, high-frequency, high-power	electromagnetic radiation				
	sources. Continue studying quantum effects impacting electron emission fr Theory studies to raise fundamental limits on electrical energy storage den	-				
	codes embodying both magnetohydrodynamic and particle-in-cell algorithm	-				
	power microwave sources.					
(U) (U)	MAJOR THRUST: Advance technologies for space sensors, imaging, idea	ntification and tracking	3.953	4.738	4.708	4.901
(0)	methods, and effective space situational awareness.	introducion, and tracking	5.755	1.750	1.700	1.901
(U)	In FY 2006: Studied fundamental issues of atmospheric and space environ	-				
	sensing, including propagation, image formation, and image recovery proc identify, characterize, and model parameters enabling remote sensing, loca					
	objects, particularly from space and of space objects from the ground.	ang, and procession ducting of				
(U)	In FY 2007: Continue studying fundamental issues that affect remote sens	0110				
	image formation, and image recovery processes. Continue to identify, char parameters enabling remote sensing, locating, and precision tracking of ob					
	r					
Pro	ject 2301	R-1 Line Item No. 1 Page-5 of 60			Exhibit R-2a (	PE 0601102F)

	Exhibit R-2a, RDT&E Project	DAT	DATE February 2007				
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense   Sciences		PROJECT NUI 2301 Physic	NUMBER AND TITLE SICS		
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) and of space objects from the ground. Further study of environmental effects o systems and of the effects of the medium through which the signal propagates.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Develop theoretical approaches to the surveillance and identificate both the ground and from space. Continue to study propagation of electromager formation, image recovery, and information content maximization from both g space-based sensors. Investigate methods to mitigate environmental effects on systems. Investigate atmospheric density forecast models to improve satellite of tracking.	netic energy, image round-based and sensors and sensor					
(U)	In FY 2009: Continue to investigate fundamental limits affecting ground- and of space objects. Develop improved adaptive optics and post-processing technic resolution. Study spectral, polarimetric, and temporal approaches to unresolved identification. Continue the study of fundamental processes in the solar-terrest atmospheric density to lead to physics-based methods of satellite orbit prediction	iques for improved image d space object rial system that affects					
(U) (U)	MAJOR THRUST: Research space environment to improve solar plasma theo areas of solar phenomena, space weather, magneto/ionosphere effects, space do improved space observation, better space-based communications, and the quan systems. Note: In FY 2008, Space Environment efforts previously in Project 2 moved into this Project to more accurately align Basic Research efforts in Phys	ebris, adaptive optics for atifying of risks to space 2311 in this PE were	0.000	0.000	4.949	4.913	
	In FY 2006: Not Applicable In FY 2007: Not Applicable						
	In FY 2007. Not Applicable In FY 2008: Begin using newly developed radio telescope instruments to probe environment, to study solar phenomena, and to develop innovative methods for environment as well as for heliospheric tomography. Investigate fundamental p using new grid-free, full kinetic modeling techniques and develop novel techni- electromagnetism. Continue development of ground-based and space-based set remote sensing and in situ measurement of space weather conditions. Continue fundamental physics and processes controlling solar, heliospheric, magnetosph thermospheric environments with a focus on improving forecast capabilities of environment using first principles physics models. Continue developing unders processes of energetic particle scattering in the near-Earth environment to supp	r remote sensing the space plasma modeling theory iques to include nsor technology for e to seek understanding of heric, ionospheric, and f the near-Earth space standing of fundamental					
Proj	rect 2301	1 Line Item No. 1 Page-6 of 60			Exhibit R-2a (I	PE 0601102F)	

	Exhibit R-2a, RDT&E Project Ju	stification		DATI	February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense F Sciences	Research	PROJECT NUM	ABER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> assets and to explore the solar interior as a complex system through advanced mod Continue to analyze data from DoD surveillance satellites to improve remote sensi space. Maintain focused research to investigate the neutral densities and winds abo	ng of interplanetary	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)		eather sensing. e weather models. environment in the ng solar, heliospheric, oving our ability to nd investigation of the netic modeling nt for remote sensing anding of nt to support ough advanced improve remote				
(U)		n accurate models of	0.000	0.000	8.908	8.844
(U) (U)	MAJOR THRUST: Research physical mathematics and applied analysis to develop physical phenomena to enhance the fidelity of simulation. Conduct research in electromagnetic properties of novel materials/c simulate their uses in various operational settings. Note: In FY 2008, Physical Ma previously in Project 2304 in this PE were moved into this Project to more accurate Research efforts in Physics. In FY 2006: Not Applicable	tromagnetics to omposites and thematics efforts	0.000	0.000	6.906	0.044
(U)						
(U)	In FY 2008: Continue to investigate properties of coherently propagating ultra-she through the atmosphere with an emphasis on their ability to propagate through clou target imaging. Continue to develop algorithms to simulate nonlinear optical effect and nonlinear optical media with an emphasis on designs for 199KW laser weapor investigate the dynamics of transonic/supersonic/hypersonic platforms with an emp	nds and be used for s within fiber lasers s. Continue to				
Pro		e Item No. 1 je-7 of 60			Exhibit R-29 (	PE 0601102F)
		7				

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense I Sciences	Research	PROJECT NUN 2301 Physic	BER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> release. Model the effects of the dynamics of the upper atmosphere on the stabi platforms as well as to assure the effective uses of their optical inventory. Stud reconfigurable warheads through suitable timing/placement of micro-detonator metal particle inclusions. Continue to improve methods for recognizing and tra penetrating coverings or other dispersive media that obscure targets so that rad waveforms can be used to image through foliage and clouds. Pursue the design sources which, with the help of novel materials, can transmit optimized wavefor surveillance purposes.	y the design of rs together with effects of acking targets and for ar emitting suitable of electromagnetic	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Investigate properties of coherently propagating ultra-short laser p atmosphere for their exploitation as high power microwave sources. Upgrade a nonlinear optical effects within fiber lasers and nonlinear optical media so that lasers can be realized. Initiate a modeling/simulation effort to codify the theore dynamics of transonic/supersonic/hypersonic platforms to verify that designs a optimal. Model the effects of the dynamics of the upper atmosphere on the state platforms as well as to assure the effective uses of their optical inventory. Com the airborne laser program and to the Air Force's Air Combat Command, for th platforms. Verify the design of reconfigurable warheads through suitable timin micro-detonators as well as the effects of various metal inclusions on lethality. methods for recognizing and tracking targets and for penetrating coverings or of that obscure targets. Pursue the design of electromagnetic sources which, with materials, can transmit optimized waveforms for a variety of surveillance purper code which allows the user to simulate these sources.	lgorithms to simulate simulation of various etical work on the nd operations are near bility of high altitude municate these results to e latter's high altitude g/placement of Continue to improve other dispersive media the help of novel				
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Non-lethal Stunning/Immobilizing Weapons In FY 2006: Accelerated fundamental scientific investigations in non-lethal st weapons research. In FY 2007: Not Applicable. In FY 2008: Not Applicable.	tunning and immobilizing	0.724	0.000	0.000	0.000
(U)	In FY 2009: Not Applicable. Total Cost		23.094	27.739	41.282	41.380
Pro	oject 2301	1 Line Item No. 1 Page-8 of 60 8			Exhibit R-2a (	PE 0601102F)

SUDGET ACTIVITY       Image: Research       PROJECT NUMBER AND TITLE (60110267 Defenses Research)       PROJECT NUMBER AND TITLE (201 Physics         (U)       C. Other Program Funding Summary (S in Millions)       FY 2005       FY 2007       FY 2008       FY 2010       FY 2011       FY 2012       FY 2013       Cost to: Complete         (U)       Related Activities:       (U)       FS 002203R, Aerospace Propulsion.       Estimate       Estimate       Estimate       Estimate       Complete       Total Cost         (U)       PE 0002500F.       Multi-Disciplinary Space Technology.       (U)       PE 0002500F.       Multi-Disciplinary Space Technology.       (U)       PE 0002500F.       (U)       (U)       PE 0002500F.       (U)       (U)       PE 0002500F.       (U)       (U)       (U)       PE 0002500F.       (U)       (U)		Exhibit	R-2a, RD	C&E Projec	ct Justifi	cation		DATE	-ebruary 2007
FY 2006       FY 2007       FY 2008       FY 2009       FY 2011       FY 2012       FY 2013       Coastio         (U)       Related Activities:       Estimate       Estima					0	601102F Defen		PROJECT NUMBE	
Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete         101 Relate Activities:         (1) PE 0602203F, Aerospace Propulsion.         (1) PE 0602203F, Aerospace Sensors.         (1) PE 0602500F, Multi-Disciplinary Space Technology.         (1) PE 0602203F, Directed Energy Technology.         (1) PE 0602203F, Directed Energy Technology.         (1) D. Acquisition Strategy Not Applicable.	(U) <u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u>	<u>fillions)</u>						
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li> <li>(U) PE 0602601F, Space Technology.</li> <li>(U) PE 0602605F, Directed Energy Technology.</li> <li>(U) DE 0602605F, Directed Energy Technology.</li> <li>(U) DE 0602605F, Directed Energy Technology.</li> <li>(U) DE 0602605F, Directed Energy Technology.</li> <li>(U) DAcquisition Strategy Not Applicable.</li> </ul>									I OTAL COST
	<ul> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li> <li>(U) PE 0602601F, Space Technology.</li> <li>(U) PE 0602605F, Directed Energy Technology. This project has been coordinated</li> <li>(U) D. Acquisition Strategy</li> </ul>								
A Project 2501 Page-9 01 60 Exhibit R-2a (PE 0601102F)	Project 2301				R-1 Line Item Page-9 of				Exhibit R-2a (PE 0601102F)

		Exhibit R-	2a, RDT&E	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY asic Research					IBER AND TITL 02F Defense ces		23	OJECT NUMBE		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2302	Solid Mechanics and Structures	13.844	17.028	17.029	17.270	19.132	18.334	18.678	19.438	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	A. Mission Description and Budget Solid mechanics and structures basic rephenomena ranging from micro-level and safe, reliable operation of superior sensors, actuators, and control system topics include: the modeling of non-line mechanical behavior of nano-material	research aims t deformation a r Air Force we s integrated to near static/dyn	o improve loa nd fracture of a apon and defe accomplish da amic behavior	materials to the systems amage control of structures	he structural dy s. Fundamenta l, thermal man	ynamics of lar al knowledge o agement, vibr	ge platforms. of "multi-func ation reductio	The goals are tional" structu n, and reconfig	e cost-effective res with smar gurable shape	e development t materials, s. Research	
(U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Explore the integ devices into turbine engines, air vehic mechanics criteria for system integrat	gration of adva	nced materials	-			<u>FY 20</u> 6.8		<u>7 2007</u> 8.040	<u>FY 2008</u> 8.076	<u>FY 2009</u> 8.196
	In FY 2006: Conducted research in the micro-/nano-mechanics, autonomics, aerospace structures with improved per to include the integration of energy has research to develop the fundamental be aerospace material systems and device Developed and exploited methods that new material systems and devices at r	and thermal m erformance ch arvesting/stora knowledge req es and to predi t combine info	anagement to aracteristics. C ge functions in uired to design of their perfor prmation techn	enable safer a Conducted res nto load-beari n and manufac mance and str	and more dural earch on the au ng structures. cture multi-fur ructural integri	utonomics Supported actional ity.					
(U) (U)	In FY 2007: Expand research in the a micro-/nano-mechanics, autonomics, harvesting to enable safer and more d characteristics. Further develop the furmulti-functional aerospace material spintegrity. Continue developing and exmodeling in the design of new materia. In FY 2008: Expand research in the a integrated antenna functions of broad	reas of diagnor thermal manag urable aerospa indamental kno ystems and dev ploiting metho al systems and area of multifu	stics, prognost gement, atomic ce structures v owledge requir vices and to pr ods that combi devices at mu nctional comp	c-scale model with improved red to design edict their per ne informatio litiple scales. osite systems	ing, and energ l performance and manufactur formance and n technology a with structura	re structural and lly					
Proje	oct 2302				I Line Item No. 1 Page-10 of 60 <b>10</b>					Exhibit R-2a (P	E 0601102F)

	Exhibit R-2a, RDT&E Project Jus	stification		DAT	E February	2007	
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Sciences			PROJECT NUMBER AND TITLE 2302 Solid Mechanics and Structures		
(U) (U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) in the areas of diagnostics, prognostics, autonomics, self-healing, thermal managem harvesting/storage, and micro-/nano-mechanics to enable safer and more durable as with improved performance characteristics. Further develop the fundamental know design and manufacture multifunctional aerospace material systems and devices an performance and structural integrity. Continue developing and exploiting methods information technology and multi-scale modeling in the design of new material syst In FY 2009: Continue research in the area of multifunctional hybrid composite syst neutralization of exogenous threats to load-bearing capability. Continue research in diagnostics, prognostics, autonomics, self-healing, thermal management, energy has electromagnetic energy radiation/transmission, and micro-/nano-mechanics to enable durable aerospace structures with improved performance characteristics. Further def fundamental knowledge required to design and manufacture multi-functional aeros and devices and to predict their performance and structural integrity. Continue devices exploiting methods that combine information technology and multi-scale modeling material systems.	erospace structures ledge required to d to predict their that combine tems and devices. tems for sensing and the areas of rvesting/storage, le safer and more evelop the pace material systems eloping and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)							
(U) (U)	MAJOR THRUST: Analyze structural fatigue and mechanics, adaptive structures, properties to improve the design, robustness, and performance of air and space systemulti-mission unmanned aerial vehicles (UAVs). In FY 2006: Explored methods for constructing and modeling morphing structures operational capabilities. Developed novel actuation devices and materials for applied micro-UAV aircraft and space structures. Investigated metal fatigue-generation cau of compressors and turbine blades. Developed structural health monitoring technique Explored the mechanical and dynamic behavior of micro-/nano-scale structures. Explenomena, such as structural deformation and aero-elastic effects, in novel structure In FY 2007: Continue to explore novel methods for constructing and modeling mod	ems to include that broaden system cations such as sed by the vibration ues and systems. ploited nonlinear ral applications. rphing structures that	7.002	8.988	8.953	9.074	
Pro		knowledge of odologies. Continue n of mechanical and			Exhibit R-2a (	PE 0601102F)	

Exhibit R-2a, RDT&E Projec	t Justificati	on			DATE	February	2007
BUDGET ACTIVITY 01 Basic Research			TLE se Research		PROJECT NUMB 2302 Solid Me Structures		k
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>			<u>FY 20</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
as structural deformation and aero-elastic effects in novel structural application							
(U) In FY 2008: Develop novel theoretical and experimental methods for constru	-	-					
morphing structures that broaden system operational capabilities. Continue de	-						
actuation devices and materials for a variety of Air Force applications to aircu Study the science issues related to the introduction into new structural concer	-						
developed under the advanced materials programs. Use the knowledge acquir							
materials to develop new aerospace structural concepts. Develop an integrate							
systems lifetime prognosis. Continue the development of structural health mo							
techniques towards an integrated vehicle-wide approach. Consolidate the exp							
dynamic behavior of micro-/nano-scale structures. Expand the investigation of	-						
associated with the structural deformation and aero-elastic instabilities and lin	mit-cycle vibrat	ion to					
<ul><li>include novel structural concepts.</li><li>(U) In FY 2009: Expand the novel theoretical and experimental methods in mor</li></ul>	phing aircraft s	ructures to					
achieve broader operational capabilities. Utilize novel actuation devices and i							
aircraft and space structural applications. Expand the study of the science rela							
new structures of the novel materials developed under the advanced materials	s programs. Use	this					
acquired knowledge to develop new aerospace structural concepts. Continue	-						
structural health monitoring sensors and techniques towards an integrated veh							
Consolidate an integrated approach to structural systems lifetime prognosis a	-	-					
understanding of mechanical and dynamic behavior of micro-/nano-scale stru structural concepts. Continue investigation of nonlinear phenomena associate	-						
deformation and aero-elastic instabilities and limit-cycle vibration to include							
(U) Total Cost		· · F · · · ·	13.8	844	17.028	17.029	17.270
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>							
FY 2006 FY 2007 FY 2008	FY 2009	<u>FY 2010</u>	<u>FY 2011</u>	FY 2012	FY 2013	Cost to	
<u>Actual Estimate Estimate</u>	Estimate	Estimate	<u>Estimate</u>	Estimate			LOTAL COST
(U) Related Activities:							
(U) PE 0602102F, Materials.							
(U) PE 0602201F, Aerospace							
Flight Dynamics.							
(U) PE 0602202F, Human	D 1 line Itom No.	1					
Project 2302	R-1 Line Item No. Page-12 of 60	1				Exhibit R-2a (F	PE 0601102F)
	12					, i	,

		DATE
	R-2a, RDT&E Project Justification	February 2007
UDGET ACTIVITY 1 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2302 Solid Mechanics and Structures
り <u>C. Other Program Funding Summary (\$ in Mil</u>	lions)	
Effectiveness Applied		
Research.		
J) PE 0602203F, Aerospace		
Propulsion. J) PE 0603211F, Aerospace		
Structures.		
	ance 21 process to harmonize efforts and eliminate duplication.	
J) <u><b>D. Acquisition Strategy</b></u>	- 1	
Not Applicable.		
Project 2302	R-1 Line Item No. 1 Page-13 of 60	Exhibit R-2a (PE 0601102
10/00/2002	13	

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
					06011	02F Defense					
	Exhibit R-2a, RD1&E Project Justification       February 2         February 2         SET ACTIVITY         PE NUMBER AND TITLE 0601102F Defense Research Sciences       PROJECT NUMBER AND TITLE 2303 Chemistry       PROJECT NUMBER AND TITLE 2303 Chemistry         Cost (\$ in Millions)       FY 2006       FY 2007       FY 2008       FY 2009       FY 2010       FY 2011       FY 2012       FY 2013       Cost to Complete		Total								
2303		1						1		Continuing	TBD
(U)		, v	, , , , , , , , , , , , , , , , , , ,	0	0	0	0	0	0		
	of existing materials, controlling ener- understanding of properties regulating infrared, optical, and radar signatures novel synthesis and characterization of electromagnetics; and conventional w exploration of atomic and molecular s	gy flow and st the chemical of reaction pro f lower cost, h eaponry. Focu urface interact	orage, and reg dynamics and oducts and inte igher perform sed investigati ions that limit	ulating interact energy transformediates that ance function fons include b performance	ctions between fer processes that advance relia al and structur io-derived me of electronic of	n materials and nat foster adva able target asso ral materials, e chanisms for l devices, compa	I their environ nces in laser essment and t lectronics, an ifetime extens act power sou	ments. Studie weaponry and racking. Critic d photonic ma sion of materia rces, and lubr	s expand fund allow predictical research to aterials; nano-s als and catalys icant materials	amental ions of the pics include: structures; sis, and the s. Primary area	
(U) (U)	MAJOR THRUST: Research and cha and theoretical chemistry to model, pr advanced fuels, munitions, and counter In FY 2006: Conducted theoretical ch	aracterize mole redict, control, ermeasure tech hemistry resea	ecular dynami and exploit at miques. rch to predict	comic and mo	lecular energe w chemicals of	tics for f interests					<u>FY 2009</u> 13.874
(U)	less sensitive nano-scale energetic mar research to understand, predict, and co exhaust signature detection and contra- for propellants and propulsion system In FY 2007: Continue utilizing theor the Air Force and to guide their effici and control the reactivity and flow of control capabilities, to develop new h	terials for app ontrol the reac ol capabilities, as and to devel etical chemistr ent synthesis. energy in mol igh-energy, hi	lications in mu tivity and flow to develop ne op new high-e ry to predict pr Continue to ad ecules to impr gh density che	initions and p of energy in w high-energy nergy chemic romising new lvance researc ove exhaust s micals for pro-	oropellants. Su molecules to y, high density al laser systen chemicals of i ch to understar ignature detec opellants and p	pported improve v chemicals as. interests to ad, predict, tion and propulsion					
(U)	performance, less sensitive nano-scale In FY 2008: Develop new theoretical	e energetic ma l and computation materials of in	terials for app tional methods terest to the A	lications in m to enhance c ir Force. Cont energy flow i	unitions and p apabilities to p tinue to develo	ropellants. predict and pp new pr					
Proje	ect 2303				Page-14 of 60 14					Exhibit R-2a (P	E 0601102F)

	Exhibit R-2a, RDT&E Project Ju	ustification		DAT	⊧ February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense F Sciences	Research	PROJECT NUI 2303 Chem	MBER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> applications to signatures, battlespace awareness, propellants, munitions, and lase ability to understand and control catalysis and plasmonic structures to enhance pr applications and sensitive detection of target compounds.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue to develop new capabilities to predict molecular and macr chemicals of interest to the Air Force. Explore properties and potential of nano-so Continue to develop new experimental methods to advance understanding of reac in molecules for applications to signatures, battlespace awareness, propellants, m systems. Continue to develop novel applications of catalysis and plasmonic struct propulsion, energetics, and sensing. Explore new concepts for closed-cycle hybrid	cale energetic materials. etivity and energy flow unitions, and laser tures for applications to				
(U) (U)	MAJOR THRUST: Enhance fundamental understanding of polymer chemical str molecular engineering, processing controls, and materials technologies to develop matrix composites aimed at improving Air Force systems performance and life sp	ructures, reactivity, p advanced organic and	9.096	10.373	10.196	10.133
(U)	In FY 2006: Conducted research to enhance optical nonlinearity for laser protect Exploited nanotechnology to develop compact solar arrays, fuels cells, and power provide lightweight power sources for space assets. Exploited photorefractive pol wavefront correction in optical communication and imaging.	ion applications. r storage systems to				
(U)	In FY 2007: Continue to utilize nanotechnology to enhance chemical and physic polymers. Continue to exploit photorefractive polymer as a medium for wavefror communication and imaging. Continue to explore flexible structures that can provisensing, power generation and storage, electronics, and other functionalities for simulti-functional structures.	nt correction in optical vide functions such as				
(U)	In FY 2008: Explore power generation and power storage for warfighters based of for solar cells and fuel cells applications. Continue to explore photonic polymers polymers for communications and detections. Investigate 3-D displays based on p polymers. Polymers with controlled dielectric permittivity and magnetic permeab for advanced radar antenna applications. Controlled growth mechanisms of carbo will be investigated.	and conductive photorefractive ility will be explored				
(U)	In FY 2009: Continue to exploit nanotechnology to enhance functional and mech polymers through controlled dispersion, distribution, and placement of the nano- applications. Controlled synthesis of new polymers with improved power generate	entities for Air Force				
Pro		ine Item No. 1 ge-15 of 60 15			Exhibit R-2a (	PE 0601102F)

	Exhibit R-2a, RDT&E Project	Exhibit R-2a, RDT&E Project Justification								
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense F Sciences		PROJECT NUI 2303 Chem	MBER AND TITLE istry					
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> functions will be explored. Modeling, synthesis, and characterization of conjug conducted to understand, and enhance the charge mobility of organic based ser and polymers.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>				
(U) (U) (U)	MAJOR THRUST: Expand the fundamental chemistry and physics of surfaces pertaining to corrosion protection, wear reduction, and power storage for air an In FY 2006: Conducted research on theoretical and predictive methods for the understanding of the structure and reactivity of surfaces and how surfaces inter environment at the interface. Investigated phenomena at surface interfaces, incl growth, friction and wear, lubrication, corrosion and degradation, sensing, elec storage, and electrochemically induced reaction products and kinetics. Synthes novel multi-functional surface structures, coatings, covers, and lubricants. Expl	d space systems. fundamental act with their luding thin film and alloy trochemical energy sized and characterized	6.707	7.514	7.459	7.473				
(U)	structures and systems for electronic, power, and sensing applications. In FY 2007: Explore theoretical and predictive methods for the fundamental u structure and reactivity of surfaces and how surfaces interact with their environ Continue to investigate phenomena at surface interfaces, including friction and corrosion and degradation, sensing, electrochemical energy storage, and electroc reaction products and kinetics. Continue to create and characterize novel multi- structures, coatings, covers, and lubricants. Investigate novel biophysical mech survivability in compact electronic, power, and sensing applications.	ament at the interface. wear, lubrication, ochemically induced -functional surface								
(U)	In FY 2008: Develop theoretical and predictive methods for the fundamental us structure and reactivity of surfaces and how surfaces interact with their environ Continue to investigate phenomena at surface interfaces, including friction and corrosion and degradation. Explore novel approaches to corrosion prevention, multi-disciplinary efforts that combine corrosion initiation, detection, and lifeti tribological investigations that focus on bridging the fundamental gap between mechanisms, including heat transfer, chemical reactivity, and atmospheric effec- investigate nano-scale surface structures for power applications.	wear, lubrication, particularly me prediction. Continue macro and nano scale cts. Continue to								
(U)	In FY 2009: Continue to develop theoretical and predictive methods for the fu of the structure and reactivity of surfaces and how surfaces interact with their e interface. Continue to investigate phenomena at surface interfaces, including fr	environment at the								
1		Page-16 of 60			Exhibit R-2a (I					

Exhibit R-2a, RDT&	E Project Justification		DATE	February	2007
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITL 0601102F Defense Sciences		PROJECT NUN 2303 Chemi		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> lubrication, corrosion and degradation. Explore novel approaches multi-disciplinary efforts that combine corrosion initiation, detect tribological investigations in nanocomposite lubricants that provide extreme environments, including space.	tion, and lifetime prediction. Continue	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: New Methods for Designing and Tes 2006, this add was called Al Alloys Used in Aging Aircraft)</li> <li>(U) In FY 2006: Conducted research on corrosion protection of Alum</li> <li>(U) In FY 2007: Conduct research to explore environmentally friendl coatings for aging aircraft.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable</li> </ul>	ninum Alloys used in aircraft.	1.351	1.559	0.000	0.000
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Fully-Integrated Solar-Powered Interior</li> <li>(U) In FY 2006: Not Applicable</li> <li>(U) In FY 2007: Conduct research to integrate solar-energy-generation light-emitting organic materials for self-contained lighting system</li> <li>(U) In FY 2008: Not Applicable</li> <li>(U) In FY 2009: Not Applicable</li> </ul>	g photovoltaic materials and	0.000	0.975	0.000	0.000
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Smart Surfaces and Interfaces</li> <li>(U) In FY 2006: Not Applicable</li> <li>(U) In FY 2007: Conduct research to explore surfaces and interfaces t surroundings</li> <li>(U) IN FY 2008: Not Applicable</li> <li>(U) In FY 2009: Not Applicable</li> </ul>	that respond smartly to the	0.000	0.975	0.000	0.000
(U) (U) Total Cost		29.574	36.322	32.166	31.480
Project 2303	R-1 Line Item No. 1 Page-17 of 60			Exhibit R-2a (I	PE 0601102F)

	Exhibi	t R-2a, RD <sup>-</sup>	F&E Projec	t Justifica	tion			DATE	ebruary 2007
BUDGET ACTIVITY 01 Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences			PROJECT NUMBER AND TITLE 2303 Chemistry		
(U) <u>C. Other Program Funding Su</u>	ummary (\$ in N	<u>/Iillions)</u>							
	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> Complete
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602102F, Materials.</li> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0602500F</li> </ul>									
<ul><li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li></ul>									
(U) PE 0602601F, Space									
Technology. (U) PE 0602602F, Conventional Munitions. This project has been coordinate	d through the F	Reliance 21 pro	cess to harmor	nize efforts and	eliminate dup	lication.			
(U) <u>D. Acquisition Strategy</u> Not Applicable.									
Project 2303				R-1 Line Item No Page-18 of 60					Exhibit R-2a (PE 0601102F)
				18					

		Exhibit R-	2a, RDT&B	E Project 、	Justificatio	on			DATE	February 2	2007
	GET ACTIVITY asic Research					IBER AND TITL 02F Defense ces		23	OJECT NUMBE 04 Mathema iences	R AND TITLE	mputing
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2304	Mathematics and Computing Sciences	25.639	31.200	23.283	25.298	31.480	28.121	25.812	26.754	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	<b>A. Mission Description and Budget</b> Mathematics and computing sciences control, and innovative analytical and improved performance and control of techniques and theories. The primary computational mathematics.	basic research high performation systems and su	develops novelops nov	g methods for ough accurate	air and space models and co	systems. Basi omputational t	c research pro tools, artificial	vides fundam intelligence,	ental knowled and improved	ge enabling programming	
(U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Perform dynami and analysis of control systems enhan systems. Increasing level of efforts a this major thrust. In FY 2006: Explored cooperative co applications to swarms of smart mun small satellites. Examined control me unsteady fluid systems with applicati flight. Improved image processing an and non-destructive vehicle testing. I	cs and control neing capabiliti re required by ontrol in dynami itions, unmanne ethodologies to ons for combu- ad sensor techn	research to de es and perforr Air Force pric nic, uncertain, ed aerial vehic improve non- stion, material ologies for use	nance of adva ority that depe adversarial en eles (UAVs), a equilibrium b s processing, e in UAV con	nced air and s nds on basic re nvironments w and constellati ehavior of cor and agile auto trollers, smart	pace eserch in rith ons of nplex, nomous munitions,	<u>FY 20</u> 7.8		<u>ř 2007</u> 9.619	<u>FY 2008</u> 12.001	<u>FY 2009</u> 13.307
(U)	controls, and computational methods In FY 2007: Advance techniques for uncertain, adversarial environments v constellations of small satellites. Com non-equilibrium behavior of complex materials processing, and agile auton technologies for use in UAV controll Investigate methods for design and an systems. Develop algorithms for cont In FY 2008: Investigate emerging no	design and and vith application tinue developin a, unsteady flui omous flight. C ers, smart mun nalysis of bio-i trol of and over	alysis of coope is to swarms of ing control met d systems with Continue to ad itions, and non ispired sensin dynamic, larg	erative contro of smart munit hodologies to n applications vance image p n-destructive g systems, co ge-scale netwo	l systems in dy tions, UAVs, a improve for combustic processing and vehicle testing ntrols, and cor prks.	ynamic, and on, l sensor mputational					
	ect 2304		1	R-1	Line Item No. 1 Page-19 of 60 19					Exhibit R-2a (P	E 0601102F)

	Exhibit R-2a, RDT&E Proje	DATE	DATE February 2007			
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense R Sciences	lesearch		UMBER AND TITLE ematics and Computing	
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) uncertain, adversarial environments with applications to swarms of smart n constellations of small satellites. Conduct additional research for teams of n various altitudes in complex environments to execute assigned missions wi intervention. Advance control methodologies and modeling to improve non complex, unsteady fluid systems with applications for combustion, materia autonomous flight. Continue to advance image processing and sensor techn controllers, smart munitions, and non-destructive vehicle testing. Advance analysis of bio-inspired sensing systems, controls, and computational syster algorithms for control of and over dynamic, large-scale networks. Investiga specification, design, verification, and validation of distributed embedded s devices to exploit nonlinear dynamic phenomena with a focus on detection, systems for use in urban combat environments. In FY 2009: Further develop the design and analysis techniques for cooper dynamic, uncertain, adversarial environments with applications to swarms of and constellations of small satellites. Continue the additional research for te operating at various altitudes in complex environments to execute assigned operator intervention. Continue developing control methodologies to impro- of complex, unsteady fluid systems. Continue to advance image processing use in UAV controllers, smart munitions, and non-destructive vehicle testir design and analysis of bio-inspired sensing systems, controls, and computat development of algorithms for control of and over dynamic, large-scale net algorithms for specification, design, verification, and validation of distribut Design novel devices to exploit nonlinear dynamic phenomena with a focus and control systems for use in urban combat environments.	nicro air vehicles operating at th variable operator n-equilibrium behavior of ls processing, and agile tologies for use in UAV methods for design and ms. Continue development of the theory and algorithms for systems. Research potential , classification, and control rative control systems in of smart munitions, UAVs, eams of micro air vehicles missions with variable ove non-equilibrium behavior and sensor technologies for ng. Develop methods for tional systems. Continue works. Develop theory and ted embedded systems.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	MAJOR THRUST: Research physical mathematics, applied analysis, and FY 2008, Physical Mathematics efforts previously in this Project were mov PE to more accurately align Basic Research efforts in Physics. In FY 2006: Developed more accurate models of physical phenomena to essimulations. Investigated properties of coherently propagating ultra-short la atmosphere. Developed algorithms to simulate nonlinear optical effects with	red into Project 2301 in this nhance the fidelity of aser pulses through the hin fiber lasers and nonlinear	8.365	10.123	0.000	0.000
Der	pject 2304	R-1 Line Item No. 1 Page-20 of 60			Exhibit R-2a (F	

	Exhibit R-2a, RDT&E Project Ju		DATE February 2007				
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense I Sciences			MBER AND TITLE	omputing	
(U)	optical media. Studied the dynamics of transonic/supersonic/hypersonic platforms, reconfigurable warheads through suitable placement and of micro-detonators. Imp recognizing and tracking targets and for penetrating coverings or other dispersive r targets.	roved methods for media that obscure	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Continue to develop enhanced models of physical phenomena to adv simulations. Further investigate properties of coherently propagating ultra-short lat atmosphere. Continue to develop algorithms to simulate nonlinear optical effects v nonlinear optical media. Continue to investigate the dynamics of transonic/superso platforms. Further study the design of reconfigurable warheads through suitable pl micro-detonators. Continue to improve methods for recognizing and tracking target coverings or other dispersive media that obscure targets.	ser pulses through the within fiber lasers and nic/hypersonic acement of					
(U) (U)	In FY 2008: None In FY 2009: None						
(U)							
(U) (U)	contingencies, target tracking, and strategic/tactical planning for battlespace inform Developed innovative methods and algorithms that will improve modeling and sim Continued to integrate new multi-disciplinary design optimization strategies with I time-accurate solutions for superior design of jet engines, directed energy devices, penetrators, air and space components, and system health and maintenance system mathematical method for solving large or complex problems in logistics, air mobil target tracking, and strategic/tactical planning for battlespace information manager computational research on the simulation uncertainty in non-linear models of aeroe structural failure predictions.	nd modeling and mostics, air mobility nation management. nulation capabilities. nigh-order, munitions and s. Developed ity contingencies, ment. Conducted dynamic flows and	9.460	11.458	11.282	11.991	
(U)	In FY 2007: Continue to elucidate complex problems in system diagnostics/progn contingencies, target tracking, and strategic/tactical planning for battlespace inform Continue to develop innovative methods and algorithms that will improve modelin capabilities. Continue to integrate new multi-disciplinary design optimization strat	nation management. g and simulation					
Pro		ne Item No. 1 e-21 of 60			Exhibit R-2a (	PE 0601102E)	
		21				- E 00011021 )	

Exhibit R-2a, RDT&E Project Jus	Exhibit R-2a, RDT&E Project Justification						
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences		BER AND TITLE				
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> time-accurate solutions for superior design of jet engines, directed energy devices, n penetrators, air and space components, and system health and maintenance systems. mathematical method for solving large or complex problems in logistics, air mobility target tracking, and strategic/tactical planning for battlespace information manageme enhance uncertainty analysis in non-linear models of aerodynamic flows and structu predictions.	Continue to develop y contingencies, ent. Continue to	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
<ul> <li>(U) In FY 2008: Continue to develop mathematical methods for solving large and complogistics, system diagnostics/prognostics, air mobility contingencies, target tracking, strategic/tactical planning for battlespace information management. Approaches will rigorous analytical tools, and meta heuristic searches. Continue to develop innovativ numerical algorithms that will improve modeling and simulation capabilities in orde understanding, prediction, and design of large and complex phenomena of interest to These phenomena include aerodynamics for various flight regimes, high power micri design and structural mechanics. Continue to develop and integrate new multi-discip optimization strategies with high-order, time-accurate solutions for superior design of directed energy devices, munitions and penetrators, micro air vehicles, air and space system health and maintenance systems. Enhance uncertainty quantification based o analysis in non-linear models of aerodynamic flows and structural failure prediction mathematical models that are dynamically evolving that would deal with operationa possibly incomplete, uncertain, conflicting, or overlapping.</li> <li>(U) In FY 2009: Develop rigorous mathematical methods for solving large and comple logistics austem diagnestics/prognostics air mobility contingencies target tracking.</li> </ul>	, and l include both ve mathematical and er to increase to the Air Force. rowaves, material blinary design of jet engines, e components, and on rigorous error s. Develop l data that are x problems in						
logistics, system diagnostics/prognostics, air mobility contingencies, target tracking, strategic/tactical planning for battlespace information management. Enhance the ana developments in operation research, meta heuristic searches, and robust and stochast Focus on developing innovative and accurate mathematical and numerical algorithm modeling and simulation capabilities. These phenomena include aerodynamics as ap of flight regimes such as hypersonics and micro air vehicles. Continue to develop an multi-disciplinary design optimization strategies with high-order, time-accurate solu design of jet engines, directed energy devices, munitions and penetrators, air and spa system health and maintenance systems. Continue to enhance uncertainty analysis ir of aerodynamic flows and structural failure predictions. Continue to develop mather	alytical tool tic optimization. as that will improve oplicable to a range and integrate new attions for superior ace components, and a non-linear models matical models that						
	22 of 60		Exhibit R-2a (I	PE 0601102F)			

		Exhibit	R-2a, RD1	&E Projec	t Justificat	tion			DATE	February	2007	
	GET ACTIVITY asic Research				0601	0601102F Defense Research 2304				DJECT NUMBER AND TITLE D4 Mathematics and Computing iences		
U)	<b>B. Accomplishments/Planned H</b> are dynamically evolving that we conflicting, or overlapping.			a that are poss	ibly incomplete	e, uncertain,	<u>FY 20</u>	<u>)06</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
U)	Total Cost						25.0	539	31.200	23.283	25.298	
U)	C. Other Program Funding Sur	-										
		<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> Estimate	FY 2010 Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate		<u>Cost to</u> <u>Complete</u>	I OTAL COST	
U)	Related Activities:	Actual	Lstinate	Listimate	Lstimate	Lstinde	Lstimate	Lstillat	<u>e Estimate</u>	complete	1	
	PE 0602201F, Aerospace											
	Flight Dynamics.											
U)	PE 0602203F, Aerospace											
	Propulsion.											
,	PE 0602500F,											
	Multi-Disciplinary Space											
	Technology.											
	PE 0602602F, Conventional											
	Munitions. PE 0602702F, Command,											
	Control, and Communications.											
	PE 0603789F, C3I Advanced											
	Development.											
	This project has been coordinated	l through the R	eliance 21 prod	cess to harmon	ize efforts and	eliminate dupl	ication.					
m	<b>D.</b> Acquisition Strategy	U	I			1						
0)	Not Applicable.											
	Not Applicable.											
					R-1 Line Item No							
	ect 2304				Page-23 of 60					Exhibit R-2a (F		

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY Isic Research					IBER AND TITL 02F Defense ces			PROJECT NUM 2305 Electro	BER AND TITLE	
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	· · ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate			
2305	Electronics	29.003	35.400	33.163	33.001	40.215	38.336	38.03			TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0	0	
c c a e t	Electronics basic research generates and levice implementation schemes vital to control, electronic countermeasures, sudvances processing and fabrication sub electronic, sensor, and optoelectronic preakthroughs essential for future leap system power, size, mass, and lifecycl	to advance Air tealth technolociences, and do structures and os in warfighte	Force operation	onal capabilit cted energy w plements adv ot implementa	ies in surveilla veapons. Solid vanced physica tion schemes.	ance, information l-state electron al modeling an Research stre	ion and signal lics research d d simulation o sses high-risk	l processing liscovers an capabilities c, far-term, g	, communicat d develops ne essential to ev game-changing	ions, command w materials, valuate novel g capability	and
(U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Investigate novel architecture and implementation scher system reliability, survivability, and f size, and mass. Research is focused or devices, and circuit concepts enabling high-speed and high-throughput data	detector and on mes important unctionality w h high-risk, im for future ger processing, hig	electronic mate to future mili- hile simultane novative, and p peration high-s gh-density nor	tary space pla ously reducin potential-brea ensitivity mu u-volatile data	tforms for incr g component j kthrough mate ltispectral dete storage, and a	reased power, erials, ection,	<u>FY 20</u> 6.2		<u>FY 2007</u> 7.805	<u>FY 2008</u> 7.832	<u>FY 2009</u> 7.882
(U) 1 (U) 1	high-power, broad-band, highly effici In FY 2006: Concluded major effort t university center of excellence on rad results from basic research efforts to b re-vectored the new university nanosa In FY 2007: Investigate novel materia entire program. Conclude research eff transition to major Defense Advanced nanosatellite projects to key DoD and launches for the best nanosatellite pro	o understand I iation effects o paseline galliu itellites project ils for reconfig forts on wide b I Research Pro commercial s	RF pulse effect on electronic n m nitride bulk ts. gurable electro pandgap galliu jects Agency (	ts on electron naterials and o material. Clo nics produceo m nitride mat (DARPA) pro	ic circuits. Lau devices. Transi sely reviewed d from major re erials and devi ogram. Link un	itioned the and eview of ices and iversity					
	In FY 2008: Investigate novel reconf for dynamically tailoring their physica electric and/or magnetic fields, optica	al properties v	ia application	of one or mor	e 'stimuli', suc	h as					
Proje	ct 2305				1 Line Item No. 1 Page-24 of 60 <b>24</b>	l				Exhibit R-2a (F	PE 0601102F)

Exhibit R-2a, RDT&E	DAT	DATE February 2007			
BUDGET ACTIVITY 01 Basic Research		PE NUMBER AND TITLE 0601102F Defense Research Sciences			
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> end objective of precisely tuning their physical properties in response electronic and/or optoelectronic device, circuit, or system requirement radiation induced degradation and/or changing mission requirements multispectral and multi-phenomenology-based detector concepts/app material electronic bandgap and defect-band tuning concepts, absorpt detection mechanisms, novel material and device functionality, nove interconnect schemes, and biologically-based detection processes.</li> <li>(U) In FY 2009: Continue investigating novel innovative reconfigurable materials, material bandgap and defect-band tuning concepts, pheno mechanisms, novel hetero-material interfacing and interconnect scheme biologically-based detection processes. Investigate 'smart' reconfigu- be dynamically tailored via self-programming or system software in mission needs. Focus on novel 'programmable pathways' to enable t</li> </ul>	ents, such as that driven by natural or s. Investigate innovative proaches utilizing breakthroughs in ption phenomenology-based el hetero-material interfacing and e multifunctional electronic menology-based detection emes, and novel nanoscience and rable materials whose properties can response to changing behavior or	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>systems such as metamorphic and heterogeneous systems.</li> <li>(U)</li> <li>(U) MAJOR THRUST: Investigate quantum and optoelectronic materia information processing, as well as nano-science for wide-field spect communication systems in order to achieve communications and specto include surveillance, target tracking, and target signature identific</li> </ul>	ral sensors and critical, high-speed ectral dominance of the battlespace	12.189	14.981	14.332	14.107
<ul> <li>(U) In FY 2006: Investigated nonlinear optical and laser materials, deviradiation protection, cloaking and tracking, and target signature ider nanophotonics, and other advanced optoelectronic and electronic materials consumption, high-efficiency lasers wavelength-diverse, high sensitive optical memory technologies for enhanced data storage. Continued to miniature terahertz frequency spectrum devices and quantum cascad communication network technologies, room temperature ferromagnes system electronics and sensors with atmospheric and space environm</li> <li>(U) In FY 2007: Further investigate nonlinear optical and laser material for radiation protection, cloaking and tracking, and target signature in the sense of the sense.</li> </ul>	ices, and fabrication processes for ntification. Explored nanoelectronics, aterials and devices for lower power ivity detectors. Studied advanced to probe robust monolithic and le lasers. Continued to investigate etic materials, and the interaction of nents. ls, devices, and fabrication processes				
for radiation protection, cloaking and tracking, and target signature is nanoelectronics, nanophotonics, and other advanced optoelectronic for lower power consumption, high-efficiency lasers wavelength-div	and electronic materials and devices				

	Exhibit R-2a, RDT&E Project Jus	stification		DAT	DATE February 2007		
	DGET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Sciences		PROJECT NUI 2305 Electr	NUMBER AND TITLE Ctronics		
(U)			<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	Further the examination of advanced optical memory technologies for enhanced datechnologies for robust monolithic and miniature terahertz frequency spectrum devices cascade lasers. Continue to investigate communication network technologies, room ferromagnetic materials, and the interaction of system electronics and sensors with space environments.	ces and quantum temperature					
(U)	In FY 2008: Continue to investigate nonlinear optical and laser materials, devices, processes for radiation protection, cloaking and tracking, and target signature identic explore nanoelectronics, nanophotonics, spintronics and other advanced optoelectron materials and devices for lower power consumption, high-efficiency lasers waveler sensitivity detectors. Further the examination of advanced optical memory technoloc data storage, including negative index of refraction metastructures. Investigate tech monolithic and miniature terahertz frequency spectrum devices and quantum cascade investigate communication network technologies, room temperature ferromagnetic interaction of system electronics and sensors with atmospheric and space environm	fication. Continue to onic and electronic gth-diverse, high gies for enhanced nologies for robust de lasers. Continue to materials, and the					
(U)	In FY 2009: Further investigate nonlinear optical and laser materials, devices, and for radiation protection, cloaking and tracking, and target signature identification. C nanoelectronics, nanophotonics, spintronics, multi-functional materials, and other a optoelectronic, magnetic, and electronic materials and devices for lower power con high-efficiency lasers wavelength-diverse, high sensitivity detectors. Further the ex advanced optical memory technologies for enhanced data storage, including negative metastructures and photonic crystals. Investigate technologies for robust monolithic terahertz frequency spectrum devices and quantum cascade lasers, as well as plasm investigate communication network technologies, room temperature ferromagnetic interaction of system electronics and sensors with atmospheric and space environm	fabrication processes Continue to explore dvanced sumption, amination of ve index of refraction e and miniature onics. Continue to materials, and the					
(U) (U)	MAJOR THRUST: Exploit advances in nanotechnology to support multi-spectral	letection technology	3.818	5.266	5.290	5.254	
(U)	and chip-scale optical networks.	actures and led wave and free ship-scale optical			0.270		
Pro		e Item No. 1 -26 of 60			Exhibit R-2a (I	PE 0601102F)	
	· · · · · · · · · · · · · · · · · · ·	26				,	

	Exhibit R-2a, RDT&E Proj∉	DATE	DATE February 2007			
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense I Sciences		PROJECT NUM 2305 Electro	IMBER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	high-speed information processors. Explored nanophotonic concepts for in components and systems.	formation processing				
(U)	In FY 2007: Develop techniques to control growth of self-assembled quar connections to these structures for multi-spectral image processing. Contin nanoelectronics and nanophotonics for guided wave and free space optoele and methods for their integration to enable chip-scale optical networks that interconnect problems. Continue exploring nanophotonic concepts for info	nue developing ectronic device technology t will overcome future				
(U)	components and systems. In FY 2008: Further develop and refine techniques to control growth of se					
(U)	structures and connections to these structures for multi-spectral image proc structural materials and improve growth methods. Continue developing na nanophotonics for guided wave and free space optoelectronic device techn integration to enable chip-scale optical networks that will overcome future Continue exploring nanophotonic concepts for information processing com In FY 2009: Exploit controlled growth of self-assembled quantum structur structures for multi-spectral image processing. Continue testing functional and improve growth methods. Continue developing and improving knowle nanophotonics for guided wave and free space optoelectronic device techn integration to enable chip-scale optical networks that will overcome future Continue exploring nanophotonic concepts for information processing com	noelectronics and ology and methods for their interconnect problems. nponents and systems. res and connections to these ities of structural materials edge of nanoelectronics and ology and methods for their interconnect problems.				
(U) (U)	MAJOR THRUST: Investigate quantum electronic solids phenomena to e magnetic, negative index, and nanoscopic materials to produce supercondu power generators and magnets, and for advanced sensors, communications processing, and ultra-dense memory.	acting tapes for compact	5.022	5.689	5.709	5.758
(U)	In FY 2006: Conducted research on superconducting quantum computing techniques. Examined methodologies to fabricate high current, high-tempe materials for enhanced power generation and storage devices. Continued to magnetic materials for power devices, switches, and bearings in aircraft ele	erature superconducting o develop high-temperature				
(U)	In FY 2007: Exploit methodologies to fabricate new high current, high-ten materials for enhanced power generation and storage devices. Continue sea	mperature superconducting				
	indexing for emanced power generation and storage devices. Continue set	R-1 Line Item No. 1				
Pro	ject 2305	Page-27 of 60			Exhibit R-2a (F	PE 0601102F)

Exhibit R-2a, RDT&E Projec	Exhibit R-2a, RDT&E Project Justification						
DGET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Sciences		PROJECT NUM 2305 Electro				
B. Accomplishments/Planned Program (\$ in Millions) superconductors. Continue to develop high-temperature magnetic materials f and bearings in aircraft electrical systems. Continue search for three-dimensi materials in the infrared and visible regions, and use these materials to make smaller size and increased functionality.	onal negative index	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
) In FY 2008: Recent success in increasing current-carrying properties of high superconducting short sections of tape will be exploited to increase those pro and attempts will be made to reduce eddy-current loses. Microwave properties superconductors will receive added emphasis because of recent progress in refrequencies. The goal is to provide thin-film superconducting material that car systems and compact communications systems. The search for practical ever superconductors will continue. Efforts to create true 3-D negative index material high-energy-product magnetic materials will continue using innovative nano carbon nanotubes and other nanomaterials, new compact architectures will be miniaturize devices for signal processing, memory storage, and sensing.	perties in longer lengths es of high-temperature educing losses at high an provide improved radar higher-temperature erial at frequencies from temperature, material technology. Using						
) In FY 2009: Using improved planar thin-film Josephson-junction technology wide-bandwidth amplifier will be constructed and tested. Attempts to fabrical high-performance magnetic materials will be given greater emphasis in provi Electric Airplane and other advanced systems. Studies to reduce eddy-curren quenching in superconducting tapes will be augmented as the tape technology Progress in seeking practical negative index materials over a broad range of the Nanoelectronic circuitry based on nanomaterials and new concepts also will attempting to promote miniaturization, greater functionality and lower losses higher-temperature (and practical) superconductors will continue.	te high-temperature, iding support for the More t losses and to prevent y reaches desired goals. frequencies will continue. receive added emphasis in						
) CONGRESSIONAL ADD: Nanophotonic Components		1.737	1.659	0.000	0.000		
<ul> <li>In FY 2006: Conducted Congressionally-directed effort for nanophotonic co electronic materials in a number of aircraft, ship, and soldier systems.</li> <li>In FY 2007: Conduct basic research in nano-materials and nano-manufacture</li> </ul>	-						
applications ) In FY 2008: Not Applicable.							
	R-1 Line Item No. 1						
roject 2305	Page-28 of 60			Exhibit R-2a (F	PE 0601102E)		

	DATE	February	2007							
BUDGET ACTIVITY 01 Basic Research				060 <sup>-</sup>	UMBER AND TI 1102F Defen ences	TLE se Research		ROJECT NUMBI		
<ul> <li>(U) <u>B. Accomplishments/Planned P</u></li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> </ul>	Program (\$ in	<u>Millions)</u>				<u>FY 20</u> 29.0		<u>Y 2007</u> 35.400	<u>FY 2008</u> 33.163	<u>FY 2009</u> 33.001
<ul> <li>(U) <u>C. Other Program Funding Sum</u></li> <li>(U) Related Activities:</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0602702F, Command, Control, and Communications.</li> <li>(U) PE 0603203F, Advanced Aerospace Sensors.</li> <li>(U) PE 0603789F, C3I Advanced Development. This project has been coordinated</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	FY 2006 Actual	FY 2007 Estimate		FY 2009 Estimate		<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	FY 2013 Estimate		• Total Cost
Project 2305				Page-29 of 60					Exhibit R-2a (	PE 0601102F)
29 UNCLASSIFIED										

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	GET ACTIVITY asic Research					IBER AND TITL 02F Defense ces			OJECT NUMBE		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	· · · · ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2306		37.653	40.150	20.063	20.215	23.148	22.008	22.324	24.384	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
(U)	MAJOR THRUST: Perform non-met design new materials and composites applications. Create inorganic matrix and hybrid carbon materials to increas materials.	tallic, ceramic, with very-higl composites, fu se the strength	and hybrid m n (>1400F) and inctional mate , application, a	d ultra-high (: rials (includir and life span o	>2500F) tempor ag adhesives/ep of air and space	erature poxies), e structural	7.6		9.785	9.539	9.622
	U) In FY 2006: Conducted research to optimize the thermal and mechanical stability of oxide composites for aircraft and engine applications. Identified new approaches to designing multi-functional structural ceramics materials to enable structurally enhanced smart systems. Investigated high-temperature resistant and lightweight non-oxide ceramic materials. Conducted research on high temperature polymer matrix composites in terms of their durability in harsh environments and its processibility in fabricating high performance structural components. Developed nanomaterials and nanocomposites that will enable reduced system weight and/or size, increased operational lifetime, and multi-functional performance of load-bearing aerospace structures.										
	In FY 2007: Continue optimizing the aircraft and engine applications. Expl ceramics materials to enable structura environments. Investigate high-temper materials. Further examine innovative damage-tolerant organic, inorganic, a nanocomposites that will enable reduc	oit new approa ally enhanced serature resistant e concepts for nd polymer ma	the sto design mart systems t and joining r developing hig atrix composit	ing multi-fur for applicatio nethodologies ther temperat es. Further de	nctional structu n in extreme s for lightweig ure and more welop nanoma	nal ht ceramic terials and					
Proj	ect 2306				I Line Item No. 1 Page-30 of 60					Exhibit R-2a (P	E 0601102F)

	Exhibit R-2a, RDT&E Project Jus	DAT	E February	2007			
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense F Sciences	Research	PROJECT NUI 2306 Mater	MBER AND TITLE ials		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	multi-functional performance of load-bearing aerospace structures. In FY 2008: Continue to optimize the design of multi-functional structural ceramic structurally enhanced smart systems for application in extreme environments. Exp in improving the thermal and mechanical stability of oxide ceramic composites for applications. Further develop high-temperature resistant and joining methodologies ceramic materials. Continue to develop innovative concepts for developing higher to damage-tolerant organic, inorganic, and polymer matrix composites. Continue to de- fundamental knowledge base to exploit the use of nanomaterials and nanocomposite structures.	bloit new approaches aircraft and engine for lightweight temperature and more evelop the					
(U)	In FY 2009: Continue optimizing the design of multi-functional structural ceramic structurally enhanced smart systems for application in extreme environments. Exp of new approaches in improving the thermal and mechanical stability of oxide cera aircraft and engine applications. Continue to further develop high-temperature resis methodologies for lightweight ceramic materials. Expand the development of innov developing higher temperature and more damage-tolerant organic, inorganic, and p composites. Continue to expand the development of the fundamental knowledge bas of nanomaterials and nanocomposites in aerospace structures.	band the development mic composites for stant and joining vative concepts for olymer matrix					
(U)							
(U)	MAJOR THRUST: Research metallic materials and identify relationships between microstructures), processing, properties, and performance so as to develop affordate metallic systems for advanced engines and aerospace structural applications.	-	9.757	10.865	10.524	10.593	
(U)	In FY 2006: Conducted research on lightweight structural materials, refractory me alloys, amorphous alloys and their composites, and micro-laminated materials for s aerospace applications. Developed and verified physics-based, quantitative, predict processing, chemistry, and structure with properties and performance of metallic m	ustainable use in ive models that relate					
(U)	In FY 2007: Continue investigating lightweight structural materials, refractory me alloys, amorphous alloys and their composites, and micro-laminated materials for s aerospace applications. Further develop and verify physics-based, quantitative, pre- relate processing, chemistry, and structure with properties and performance of meta	tals, intermetallic ustainable use in dictive models that					
(U)		ural applications and					
Pro		e Item No. 1 ə-31 of 60			Exhibit R-2a (	PE 0601102F)	
		31					

		DATE	DATE February 2007									
BUDGET A 01 Basic	ACTIVITY C Research				<b>060</b> 1					PROJECT NUMBER AND TITLE 2306 Materials		
air- inte stru moo load deri effe	<ul> <li>air-vehicle structures. Explore the interaction between chemistry and mechanics in surfaces and interfaces of these nanoscale structures. Explore the processing and development of multifunctional structural metals for power systems and space applications. Capitalize on advances in multiscale modeling to study the response of aerospace alloys exposed to corrosive environments and cyclical loading. Develop an informatics process exploiting disparate sources of materials' properties data derived from modeling and experimentation. Explore the fundamental science of friction and thermal effects during friction stir processing.</li> <li>U) In FY 2009: Further investigate nano-laminates and nano-composites for aerospace armor and small</li> </ul>										<u>FY 2009</u>	
air- inte mul mul cyc mat fund	air-vehicle structures. Explore the interaction between chemistry and mechanics in the surfaces and interfaces of these nanoscale structures. Further explore the processing and development of multifunctional structural metals for power systems and space applications. Further develop and verify multiscale models to study the response of aerospace alloys exposed to corrosive environments and cyclical loading. Continue development of an informatics process to exploit disparate sources of materials' properties data derived from modeling and experimentation. Continue research on the fundamental science of friction and thermal effects during friction stir processing. Investigate affordable and environmentally sustainable methods to process aerospace alloys.											
(U) (U) CO	NGRESSIONAL ADD: Na Y2006: Established a broad	tional Aerospace	e Leadership Ir	nitiative	e research and o	levelopment	20.2	269	19.500	0.000	0.000	
(U) In F aero (U) In F	maintain US's competitive FY 2007: Support aerospace ospace equipment manufacto FY 2008: Not Applicable	R&D, fortify U		facturing suppl	y chain, and st	rengthen						
	FY 2009: Not Applicable al Cost						37.0	553	40.150	20.063	20.215	
(U) <u>C. C</u>	<u> Dther Program Funding St</u>	<u>ummary (\$ in N</u>	<u>(fillions)</u>									
		FY 2006 Actual	<u>FY 2007</u> <u>Estimate</u>	FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	Total Cost	
(U) PE (	nted Activities: 0602102F, Materials. 0602201F, Aerospace											
(U) PE(					R-1 Line Item No							

Exhibit R-2a, RD	DATE February 2007	
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2306 Materials
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
<ul> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Flight Dynamics.</li> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li> <li>(U) PE 0602601F, Space Technology.</li> <li>(U) PE 0603211F, Aerospace Structures.</li> <li>(U) PE 0708011F, Industrial Preparedness. This project has been coordinated through the Reliance 21 prod</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	cess to harmonize efforts and eliminate duplication.	
Project 2306	R-1 Line Item No. 1 Page-33 of 60 33	Exhibit R-2a (PE 0601102F)

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
	BET ACTIVITY asic Research					IBER AND TITL 02F Defense ces			ROJECT NUMBE 307 Fluid Me		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2307		15.507	14.017	12.054	12.563	19.602	17.598	15.13		Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	(	0		
	Fluid mechanics basic research advan and space vehicles. The goals are to in methods used to expand current flight research emphasis is on turbulence pro- primary approach is to perform fundar flows, prediction of real gas effects in investigated by this project are unstear turbomachinery flows.	mprove theoret performance l ediction and co mental experin high-speed fli	ical models for coundaries thro ontrol, unstead mental investig ght, and contro	r aerodynami ough enhance y and separate ations and to ol and predict	c prediction and ad understandin ed flows, subs formulate adv ion of turbuler	nd design, as wing of key fluid onic/superson anced comput ance in flight ve	vell as to original flow (primar ic/hypersonic ational metho chicles and pro-	inate flow co ily high-spee flows, and in ds for the sir opulsion system	ntrol concepts d air) phenome aternal fluid dy nulation and str ems. Primary a	and predictive ena. Basic namics. The udy of comple areas of resear	x
(U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Investigate and c boundary layers, and turbulent flows flight control systems.	characterize co	mplex phenon	-			<u>FY 20</u> 4.9	_	<u>Y 2007</u> 5.485	<u>FY 2008</u> 5.525	<u>FY 2009</u> 6.464
	In FY 2006: Explored methods to opt controls on UAVs. Modeled and vali boundary layer effects, engine inlets, phenomena in hypersonic flows with Explored control strategies for mitiga and for abating the effects of highly s	idated unsteady and plasma ae emphasis on c ting excessive eparated flows	v hypersonic fl rodynamics. M ontrol concept heat transfer a	ow simulation fodeled aeroth s and perform and unsteading	n tools to inclu hermal and loc nance optimiza ess in hyperson	ide cal shock ntion. nic flows					
	In FY 2007: Characterize and model ovortex-dominated flows and to develop explore higher-fidelity models for unsuboundary layer effects, shock-domination control strategy models for mitigating for abating the effects of highly separated to the strategy for highly separated by the separated strategy models for highly separated by the separated strategy highly separated by the separated strategy highly separated by the separated strategy highly separated by the separated strategy highly separated by the separated strategy highly separated by the separated strategy highly separated by the separated strategy highly separated strategy high	op rapid maneu steady aerodyn ated flows (eng g excessive hea	iver controls of amics of complete inlets), and	n UAVs. Val plex, hyperson 1 nonequilibri	idate current n nic flows to in ium effects. De	nodels and clude evelop					
	In FY 2008: Characterize and model boundary layers to facilitate prediction severe heating rates in high-speed systems	on and control of	of laminar-turb	oulent transition	on and the ons	et of					
Proj	ect 2307				I Line Item No. 1 Page-34 of 60 <b>34</b>					Exhibit R-2a (P	E 0601102F)

	Exhibit R-2a, RDT&E Project Just	ification		DAT	February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Res Sciences	search	PROJECT NUN 2307 Fluid	MBER AND TITLE Mechanics	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> of high-fidelity, unsteady numerical models for shock-dominated flows, and nonequi Continue development of control strategy models for mitigating excessive heat transf in hypersonic flows and for abating the effects of highly separated flows.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Extend efforts to characterize and model fundamental phenomena of hi laminar-turbulent transition to include interactions between multiple instability mode high-fidelity, unsteady numerical simulation methodologies for shock-dominated flor nonequilibrium effects. Extend strategies for control of excessive heat transfer, unste separation in hypersonic flows to reduce severe local loads on systems. Explore inter severe phenomena in aerothermodynamic environment and high-temperature vehicle goal of reducing thermal protection system complexity and increasing performance to reusability, sustainability, efficiency, and turn time of hypersonic and space-access systems.	s. Validate ws and adiness, and actions between materials with the p improve				
(U) (U)	MAJOR THRUST: Expand fundamental knowledge of unsteady flows in integrated	theoretical,	5.745	6.583	6.529	6.099
(U)	experimental, and computational efforts. Study complex rotating and internal flow pl turbomachinery and jet engine applications with an emphasis on flow control approa In FY 2006: Validated studies of advanced flow control coupling mechanisms in con flows. Validated large eddy simulation techniques to probe heat transfer and fluid flow Continued to model unsteady flow control inputs on wings and jet engines to include closed-loop flow control demonstrations. Further explored and developed models for mistuning mechanisms in multiple blade row interactions tied to high cycle fatigue fat developed control approaches for flow interactions using flow control measurement a devices for harsh environments.	ches. nplex, turbulent w coupling. reduced order, aerodynamic illures. Further				
(U)	In FY 2007: Further evaluate advanced flow control coupling mechanisms in completing including transient phenomena and time accurate simulation techniques. Evaluate recordsed-loop flow control mechanisms on unsteady flow of complex geometries and judevelop large eddy simulation techniques to include heat transfer and fluid flow coupsimulations of film cooling flows. Evaluate hybrid computational techniques for accurate turbulent flows. Evaluate coupling between aerodynamic and structural mistuning multiple blade row interactions tied to high cycle fatigue failures. Develop predictive flow control approaches using sensors and actuators for harsh environments.	luced order, et engines. Further bling in preliminary urately modeling echanisms in tools for unsteady				
(U)	In FY 2008: Further develop reduced order, closed-loop flow control mechanisms or					
Pro	ject 2307 Page-3	Item No. 1 35 of 60 35			Exhibit R-2a (	PE 0601102F)

Exhibit R-2a, RDT&E	Exhibit R-2a, RDT&E Project Justification								
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense I Sciences		PROJECT NUN 2307 Fluid I	February MBER AND TITLE Mechanics	2001				
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> complex geometries and jet engines. Investigate new applications of jet engine integration and efficiency for a wider range of flight oper predicting and controlling unsteady, vortex-dominated flows on un Explore and develop innovative techniques for improving convecti enhance thermal management of subsonic and supersonic flight sys</li> <li>(U) In FY 2009: Continue to develop reduced order, closed-loop flow flows of complex geometries and jet engines and identify specific a Characterize and model promising applications of flow control tech integration and efficiency for a wider range of flight operating cond and controlling unsteady, vortex-dominated flows on UAVs. Conti for improving convective heat transfer at all flow scales to enhance supersonic flight systems.</li> </ul>	rating conditions. Develop tools for manned aerial vehicles (UAVs). ve heat transfer at all flow scales to stems. control mechanisms on unsteady applications to transition technology. aniques to improve jet engine ditions. Validate tools for predicting inue to develop innovative techniques	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>				
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: National Hypersonic Research Center</li> <li>(U) In FY 2006: Conducted fundamental scientific and engineering res Hypersonics Research Center.</li> <li>(U) In FY 2007: Conduct research on experimental and numerical simu predictive numerical methods for physical phenomena associated w</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable</li> </ul>	search studies at the National	1.931	1.949	0.000	0.000				
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Notre Dame Center for Flow Physics a</li> <li>(U) In FY 2006: Enabled basic research in aero-optics and flow control and diagnostic equipment that directly impacts AF far term technol</li> <li>(U) In FY 2007: Not Applicable</li> <li>(U) In FY 2008: Not Applicable</li> <li>(U) In FY 2009: Not Applicable</li> </ul>	by acquiring a subsonic wind tunnel	2.896	0.000	0.000	0.000				
<ul><li>(U) In FY 2009: Not Applicable</li><li>(U) Total Cost</li></ul>		15.507	14.017	12.054	12.563				
Project 2307	R-1 Line Item No. 1 Page-36 of 60			Exhibit R-2a (I	DE 0601102E)				

Exhibit K-28, KD1 & EPOJECT JUSTIICation         February 2007           BUDGET ACTIVITY         PE NUMBER AND TITLE 001102F Defense Research         PROJECT NUMBER AND TITLE 207 Fluid Mechanics           (U)         C. Other Program Funding Summary (5 in Millions) EV 2006         EY 2007         FY 2009         FY 2010         FY 2012         FY 2013         Cost to Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Cost           (U)         Related Activities:         (U)         PE 0602102F. Actrospace Flight Dynamics.         (C)         PE 0602203F. Acrospace Structures.         Estimate 21 process to harmonize efforts and eliminate duplication.         (U)         D. Acquisition Strategy Not Applicable.												
01 Basic Research         0601102F Defense Research         2307 Fluid Mechanics           (U)         C. Other Program Funding Summary (S in Millions)         EY 2006         EY 2007         EY 2009         EY 2011         EY 2012         EY 2012         EY 2013         Cost to Complete         Total Cost           (U)         Related Activities:         (U)         Related Activities:         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Complete         Total Cost           (U)         PE0 6002201F, Acrospace         English Dynamics.         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Complete         Total Cost           (U)         PE0 6002203F, Acrospace         Estimate         Estima		Exhibit	t R-2a, RD	T&E Projec	ct Justifica	tion			DATE	February 2007		
EY 2006       EY 2007       EY 2008       EY 2009       EY 2011       EY 2012       EY 2013       Cost to Actual       Total Cost         (U)       Related Activities:       <					0601102F Defense Research 23							
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602102F, Materials.</li> <li>(U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>(U) PE 0602201F, Aerospace Propulsion.</li> <li>(U) PE 0603211F, Aerospace Structures.</li> <li>(U) PE 0603211F, Aerospace Structures.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>	(U) <u>C. Other Program Funding Sum</u>	<u>ımary (\$ in N</u>	<u>(Iillions)</u>									
	<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602102F, Materials.</li> <li>(U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0603211F, Aerospace Structures. This project has been coordinated</li> <li>(U) <u>D. Acquisition Strategy</u></li> </ul>	<u>Estimate</u>			Complete Total Cost							
R-1 Line Item No. 1       Project 2307     Page-37 of 60       37	Project 2307									Exhibit R-2a (PE 0601102F)		

		Exhibit R-	2a, RDT&E	E Project 、	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY asic Research					IBER AND TITL 0 <b>2F Defense</b> Ces			OJECT NUMBE		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2308		21.276	21.167	20.272	20.662	22.675	21.751	21.419	24.341	Continuing	TBD
	Quantity of RDT&E Articles A. Mission Description and Budget	0	0	0	0	0	0	0	0		
	Propulsion basic research expounds fur rockets, and combined cycle propulsion space power and propulsion, high altiti propulsion, and the synthesis of new co- involves the complex coupling between Non-chemical energetics research inclu- space-based energy utilization. Primar	on systems for tude signature chemical prope en energy relea ludes both plas	future rapid g characterizatio llants. These t use through cho sma and beams	lobal reach an on and contan hrusts can be emical reactio ed-energy pro	id on-demand a nination, propu- grouped into r on and the flow pulsion for ort	space access. Ilsion diagnos reacting flows processes that pit-raising spa-	Basic research tics, thermal r and non-chen at transport ch ce missions ar	n thrusts inclue nanagement o nical energetic emical reactar nd ultra-high e	de airbreathin, f space-based cs. Study of re nts, products, energy techniq	g propulsion, power and acting flows and energy.	al
(U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Research and mo electronics, miniaturization, and conta	odel space prop	oulsion and po	wer in the are	as of chemistr	у,	<u>FY 20</u> 8.1		<u>Y 2007</u> 9.118	<u>FY 2008</u> 9.109	<u>FY 2009</u> 9.257
(U)	In FY 2006: Conducted research on p Continued studies of pulsed detonation methods to predict and suppress comb contamination. Examined magnetohy performance. Continued to investigate control of advanced engines.	plasma-based, on rocket engin pustion instabil drodynamic (N	charged drople es and other n lities. Investig /IHD) flow con	ew engine con ated high altit ntrol to optim	ncepts. Evalua ude plumes sig ize scramjet fl	ted gnature and ow path					
	In FY 2007: Continue research on pla Continue to investigate pulsed detonal examine methods to predict and suppr plumes signature and contamination. flow path performance. Continue to in flow control of advanced engines.	tion rocket engress combustic Continue to in nvestigate ligh	gines and othe on instabilities. vestigate MHI tweight superc	r new engine Continue to O flow contro conducting ma	concepts. Con investigate hig l to optimize s agnet capabilit	tinue to h altitude cramjet y for MHD					
	In FY 2008: Conduct studies of small investigate plasma dynamics in these instabilities under supercritical condit design codes. Develop novel diagnost high pressure, harsh, optically thick e	thrusters. Eval tions, and deve tic techniques	uate methods lop research n for characteriz	to predict and nodels that ca ation of comb	l suppress com n be incorpora pustion instabil	bustion ted into the lities in					
Proje	ect 2308				Line Item No. 1 Page-38 of 60 38					Exhibit R-2a (P	E 0601102F)

Exhibit R-2a, RDT&E Proje	Exhibit R-2a, RDT&E Project Justification							
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense F Sciences	Research	PROJECT NUI 2308 Propu					
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> signature and contamination. Investigate alternate launch systems using electrail-gun or coil-gun. Conduct research to enable revolutionary designs of sa achieve the simultaneous objectives of increasing payload and/or time in or flexibility and scope.	tellite systems that can	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U) In FY 2009: Continue studies of small satellite, microsatellite, and nanosate investigate plasma dynamics in these thrusters. Continue to investigate high and contamination. Continue investigating alternate launch systems using el- rail-gun or coil-gun. Conduct fundamental component and system level rese- introduction of novel multi-use technologies and concepts in order to achiev architectures and the development of highly efficient power generation/reco- electro-mechanical turbines and nano-structured thermoelectric units) deepl management or spacecraft structure. Enhance novel diagnostic techniques for combustion instabilities in high pressure, harsh, optically thick environment	a altitude plumes signature lectromagnetic forces as a earch that leads to the we multi-functional satellite overy systems (e.g., micro by integrated with thermal or characterization of							
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Explore combustion, propulsion, and diagnostics in subhypersonics. Investigate multi-phase, turbulent reacting flows to improve th systems, including gas turbines, ramjets, scramjets, pulsed detonation engin FY 2008, Conduct basic research in support of higher AF priority (Energy C Initiative) to identify and develop technologies that enable the use of domes energy needs.</li> </ul>	bsonics, supersonics, and the performance of propulsion tes, and rockets. Starting in Conservation -Assured Fuels	8.266	9.222	11.163	11.405			
(U) In FY 2006: Conducted research to improve laser diagnostic measurement characterization of turbulent reacting flows. Probed deeper into molecular the enhancing thermal destabilization of hydrocarbon fuels under supercritical t Further incorporated prediction methodologies, which are both quantitativel computationally tractable, into turbulent combustion models. Enhanced scie are used to improve aerodynamic characteristics and propulsive efficiencies propellants that are more energetic, environmentally benign, and less sensiti	ransport effects causing and thermodynamic conditions. ly accurate and entific bases for how plasmas s. Investigated fuels and							
(U) In FY 2007: Continue improving laser diagnostic measurement capabilities turbulent reacting flows. Continue to investigate molecular transport effects thermal destabilization of hydrocarbon fuels under supercritical thermodyna incorporate prediction methodologies, which are both quantitatively accurat	s in the characterization of causing and enhancing amic conditions. Further							
Project 2308	R-1 Line Item No. 1 Page-39 of 60			Exhibit R-2a (	DE 0601102E)			

	Exhibit R-2a, RDT&E Project Just	Exhibit R-2a, RDT&E Project Justification								
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Sciences		PROJECT NUM 2308 Propu	MBER AND TITLE Ision	LE				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> tractable, into turbulent combustion models. Further enhance scientific bases for how to improve aerodynamic characteristics and propulsive efficiencies. Continue to inve- propellants that are more energetic, environmentally benign, and less sensitive to acc Formulate strategies for using alternate hydrocarbon fuels based on the incorporation chemistry models into large eddy simulations.	stigate fuels and idental detonations.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>				
(U)	In FY 2008: Continue improving laser diagnostic measurement capabilities, investig transport effects causing and enhancing thermal destabilization of hydrocarbon fuels thermodynamic conditions, and prediction methodologies, which are both quantitativ computationally tractable, for turbulent combustion models. Further enhance scientif plasmas are used to improve aerodynamic characteristics and propulsive efficiencies for using alternate hydrocarbon fuels based on the incorporation of detailed chemistr models through surrogate fuel representations. Conduct research to provide fuel-flex conversion technology in support of the Energy Conservation -Assured Fuels Initiati	under supercritical ely accurate and ic bases for how Expand strategies y and transport ible energy								
(U)	In FY 2009: Continue improving laser diagnostic measurement capabilities, investig transport effects causing and enhancing thermal destabilization of hydrocarbon fuels thermodynamic conditions, and prediction methodologies, which are both quantitative computationally tractable, for turbulent combustion models. Continue exploring the how plasmas are used to improve aerodynamic characteristics and propulsive efficient strategies for using alternate hydrocarbon fuels by inserting reduced fuel representation comprehensive combustion models such as large eddy simulations. Conduct research fuel-flexible energy conversion technology in support of the Energy Conservation -A Initiative.	ations of molecular under supercritical ely accurate and scientific bases for acies. Exploit ons into to provide								
(U)										
(U) (U)	CONGRESSIONAL ADD: Coal-Based Jet Fuels. In FY 2006: Conducted research to produce coal-based jet fuels in increasingly large through refinery trials. Evaluated refinery-produced fuels for large-scale combustion stability for use in advanced high-performance engines.	•	4.826	2.827	0.000	0.000				
(U)	In FY 2007: Continue research to produce coal-based jet fuels. Assess military utili this fuel.	ty and suitability of								
(U)	In FY 2008: Not Applicable.									
(U)	In FY 2009: Not Applicable									
Dro		Item No. 1 10 of 60			Exhibit R-2a (					
	· · · · · · · · · · · · · · · · · · ·	10 01 00				000 1021 )				

		Exhibi	t R-2a, RD⁻	Γ&E Projec	ct Justifica	tion			DATE	February	2007
	GET ACTIVITY Basic Research				060	UMBER AND TI 1102F Defens Inces	TLE se Research		ROJECT NUMBE 308 Propulsio	R AND TITLE	
(U) (U)	<b>B. Accomplishments/Planne</b> Total Cost	d Program (\$ in	<u>Millions)</u>				<u>FY 20</u> 21.2		<u>FY 2007</u> 21.167	<u>FY 2008</u> 20.272	<u>FY 2009</u> 20.662
(U)	C. Other Program Funding S	Summary (\$ in N	<u>/Iillions)</u>								
		<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	TOTAL COST
(U) (U)	PE 0602102F, Materials. PE 0602203F, Aerospace Propulsion.										
(0)	PE 0602500F, Multi-Disciplinary Space Technology.										
(U)	PE 0602601F, Space										
(U)	Technology. PE 0603211F, Aerospace										
	Structures. This project has been coordina	ted through the R	eliance 21 pro	cess to harmor	nize efforts and	eliminate dup	lication.				
(U)						e anna curp					
(-)	Not Applicable.										
					R-1 Line Item No						_
Pro	ject 2308				Page-41 of 60 41	)				Exhibit R-2a (F	PE 0601102F)
				ι		IED					

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY asic Research					IBER AND TITL 02F Defense ces			OJECT NUMBE	ER AND TITLE	5
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2311	Information Sciences	29.653	26.900	25.412	27.180	36.238	32.413	28.850	29.995	Continuing	TBD
NT .	Quantity of RDT&E Articles	0	0	0	0	0	0	ů	0		<u> </u>
Elema (U) 4 1 4 6 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	This project is renamed from "Space ent in FY 2008. <b>A. Mission Description and Budget</b> Information sciences basic research ge- precision targeting (or strike), and imp and distribution, and (3) conversion of on interlocking systems connected by systems are those in networks and com- research is occurring in the following forensics; and communications and sig <b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Research space e areas of solar phenomena, space weat improved space observation, better sp systems. Note: In FY 2008, Space eff this PE to more accurately align Basic In FY 2006: Explored advanced mode and speed. Sought improved plasma m fundamental processes of energetic pa for protection of space assets. Investig fundamental processes in the magneto of fundamental processes controlling environment. Exploited data from Do C/NOFS-SMEI satellites to improve optical telescope technologies to inclu- nanotechnology, advanced signal-proc Exploited developments in all-sky im- infrared observations of ionospheric p	Item Justifica enerates funda proved battlesp f information in networks lead nmunications, areas: informa gnals; control cam (\$ in Mill environment to her, magneto/ bace-based com forts previouslic casearch effecting algorithm nodels to enha article scattering gated solar pro- pophere, ionosy space plasma D surveillance remote sensing ide adaptive o cessing algorithm aging and mul	<b>Ation</b> mental knowledge into knowledge ing to a system software, info ation operation of large system <b>ions</b> ) improve solar ionosphere eff munications, y in this Proje orts in Physics as to take adva ince understan ing in the near- cesses and ener- phere, and there to improve abile assets in conj g of interplanet ptics, photon co hms, and deve	edge and unde s. Areas of res e to support d n of systems a rmation mana s (CNA and C ns. r plasma theore ects, space de and the quant ct will be mov intage of increa ding of basic Earth environ ergetic events rmosphere. Se lity to forecas unction with ary space. De letection, spece- daptive optics	erstanding to susearch focus and ecision making architecture. A agement, and h CND); network ries and model bris, adaptive tifying of risks ved into Project eased compute plasma theory ment to lay gru- , the solar wind earched for und st near-Earth sy data from eveloped ground ctral resolution -based sensor to st o obtain visil	upport critical re (1) access to g. The data, fu Areas of resear numan-system c, software and ling in the optics for to space ct 2301 in r power . Studied oundwork d, and derstanding pace nd-based h, technology. ble and	Air Force cap o disparate dat usion engines, rch underpinni interactions.	babilities in inf ta and informa and command ing these team Complementi itectures; infor	formation sup tion, (2) infor l and control f -focused, netw ng these overa	eriority, mation fusion unctions resid vork-enabled all focus areas	e
				<b>R</b> -1	1 Line Item No. 1	l					
Proje	ect 2311				Page-42 of 60					Exhibit R-2a (P	E 0601102F)

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense F Sciences	Research		ABER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> targets.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Expand development of ground-based optical telescope technologies (i.e. photon detection, spectral resolution, nanotechnology, and advanced signal-processin include radio telescopes. Continue developing space-based sensor technology. Explor as a complex system through advanced modeling techniques. Continue to explore ad algorithms to take advantage of increased computer power and speed, and to seek im models to enhance understanding of basic plasma theory. Develop understanding of processes of energetic particle scattering in the near Earth environment to support processes in the magnetosphere, ionosphere, and thermosphere. Seek understanding of processes controlling space plasma to improve ability to forecast near-Earth space er Continue to analyze data from DoD surveillance and the C/NOFS-SMEI satellites to sensing of interplanetary space. Initiate research to investigate the neutral winds abor Employ all-sky imaging to study of ionospheric plasma phenomena and develop tech these observations.	ag algorithms) to re the solar interior wanced modeling proved plasma fundamental otection of space and fundamental of fundamental vironment. improve remote ve 150 kilometers.				
(U)	In FY 2008: None					
(U)	In FY 2009: None					
(U) (U)	MAJOR THRUST: Investigate innovative technologies for space-based communica ensure continued Air Force space dominance.	tion capabilities to	0.971	0.996	1.000	1.000
(U)	•					
(U)	In FY 2007: Investigate innovative methods for optical communications such as part polarization modulation, and liquid crystal spatial modification techniques. Continue mechanisms of dual polarization antennas for space applications.					
(U)	In FY 2008: Refine the details of the investigation that partially coherent laser beam by passage through turbulent atmospheres than their classically coherent counterpart of solid state lasers which can emit such partially coherent beams. Continue to invest that the long distance stability of polarization states can be exploited to communicate messages.	s. Pursue the design igate the possibility				
		Item No. 1				
Pro		13 of 60 13			Exhibit R-2a (	PE 0601102F)

	Exhibit R-2a, RDT&E Project	DATI	DATE February 2007 PROJECT NUMBER AND TITLE				
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense I Sciences	Research	PROJECT NUM			
	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Pursue extensive modeling and simulation of the performance of partially coherent laser designs together with the propagation of partially coherent surrogate turbulent media. Monitor the polarization states to verify the predicted states to verify the predicted states are states as a state of the propagation of the propagation of the propagation of the propagation of the propagation of the propagation of the performance of the perform	rent laser beams through					
(U)							
(U)	MAJOR THRUST: Investigate signal communications, surveillance, and targe awareness and improved command and control for the battlefield commander. in linear operator theory, generalized functions and probability, harmonic methexpansions.	Efforts include research	4.184	4.827	5.411	5.705	
(U)	*	nversion across multiple					
(-)	bands into graphical and conceptualized information. Promoted methodologies	-					
	performance of new wireless mobile, networked communications systems. Ass						
	alternatives on the overall feasibility of super-resolution millimeter and search						
	Solidified the hybrid RF/free-space optical paradigm and refined the parameter						
	technologies to attain ultra-fast, reliable information exchange. Conducted rese						
	transmission technology for hyperspectral and other diverse data.						
(U)	In FY 2007: Continue exploring data fusion science to enable rapid data conve	rsion across multiple					
(0)	bands into graphical and conceptualized information. Continue to study metho	_					
	the performance of new wireless mobile, networked communications systems.						
	assessment of technical alternatives for feasibility of super-resolution millimet	-					
	imagery. Continue to investigate the hybrid radio-frequency/free-space optical						
	parameters of other innovative technologies to attain ultra-fast, reliable inform						
	to develop ultra-wide band transmission technology for hyperspectral and othe	-					
(U)	In FY 2008: Focus on integrating results in distributed navigation, geo-locatio						
(0)	telemetry to improve the collecting and interpreting of battlespace information						
	dealing with diverse, changing warfare scenarios. Continue to study methodolo						
	performance of new wireless mobile, networked communications systems. Con						
	assessment of technical alternatives for feasibility of super-resolution millimet						
	imagery. Continue to investigate the hybrid radio-frequency/free-space optical						
	parameters of other innovative technologies to attain ultra-fast, reliable inform						
an	In FY 2009: Study navigation approaches such as "optical flow field" to impro	•					
(0)	foundation for over-arching methodologies that integrate sensing data collected	•					
	R	1 Line Item No. 1					
	ject 2311	Page-44 of 60			Exhibit R-2a (	DE 0601102E)	

Exhibit R-2a, RDT&I	DATE	DATE February 2007				
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Sciences			IMBER AND TITLE nation Sciences		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> inter-communicating networks of sensor resources. Continue to technology for hyper-spectral and other diverse data. Continue to the performance of new wireless mobile, networked communicati assessment of technical alternatives for feasibility of super-resolu imagery.	o study methodologies for evaluating ions systems. Continue study and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Conduct research in complex systems and algorithms secure, and rich information systems supporting battlefield comminformation warfare techniques, intelligent agents, knowledge base learning, uncertainty reasoning, information warfare, and information</li> </ul>	handers using artificial intelligence, ses, distributed systems, machine	10.788	11.879	19.001	20.475	
(U) In FY 2006: Conducted research on information warrare, and information information intensive systems and networks. Developed informati adaptive, expert decision support. Exploited quantum and bio-con allow enhanced tracking, recognition, and characterization to imp and control, and security. Began to investigate first principles of s	ce techniques to proactively protect ion fusion science to provide deep, nputing techniques and algorithms to prove situational awareness, command					
<ul> <li>(U) In FY 2007: Continue to develop information operations science to intensive systems and networks. Further develop information fusi expert decision support. Continue to exploit quantum and bio-con allow enhanced tracking, recognition, and characterization to imp and control, and security. Continue to investigate first principles of including characteristic property metrics and begin development of analysis tools.</li> </ul>	techniques to exploit information ion science to provide deep, adaptive, nputing techniques and algorithms to prove situational awareness, command of software system architectures					
U) In FY 2008: Significantly increase investigation of first principle information system architectures including characteristic propertie of automatic software architecture analysis tools. Add research or techniques for information operations, knowledge mining, and to command and control. Continue evolving information operations information intensive systems and networks. Further develop inf deep, adaptive, expert decision support.	es and metrics, and begin development n brilliant software agents and other improve situational awareness and science techniques to exploit					
(U) In FY 2009: Continue to increase emphasis on investigating first architectures including characteristic properties and metrics and b						
Project 2311	R-1 Line Item No. 1 Page-45 of 60			Exhibit R-2a (	PF 0601102F)	

		Exhibit	t R-2a, RD1	&E Proje	ct Justifica	tion			DATE	February	2007
	GET ACTIVITY Basic Research				060 <sup>-</sup>	UMBER AND TI 1102F Defens ences			ROJECT NUMB 311 Informat	ER AND TITLE	
(U)	<b>B. Accomplishments/Planned Pro</b> software architecture analysis tools for information operations, knowle control. Continue to develop inform systems and networks. Continue de decision support.	. Continue r dge mining, nation opera	esearch on brill and to improve tions science te	e situational a echniques to e	wareness and co xploit informat	ommand and ion intensive	<u>FY 20</u>	<u>)06 F</u>	<u>EY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	CONGRESSIONAL ADD: Griffit In FY 2006: Supported educationa defense technology and research.		•		trate the applica	ation of	0.9	966	0.000	0.000	0.000
(U) (U) (U) (U)	In FY 2007: Not Applicable In FY 2008: Not Applicable. In FY 2009: Not Applicable										
(U) (U)	CONGRESSIONAL ADD: Netwo In FY 2006: Conducted fundamen information and space security effo	tal multi-dis	-	•		network	4.4	140	0.000	0.000	0.000
(U) (U) (U) (U)	In FY 2007: Not Applicable In FY 2008: Not Applicable. In FY 2009: Not Applicable Total Cost						29.0	553	26.900	25.412	27.180
(U)	C. Other Program Funding Sum	<u>nary (\$ in N</u>	<u>/lillions)</u>								
		FY 2006 Actual	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> Estimate	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	TOTAL COST
` '	Related Activities: PE 0602500F, Multi-Disciplinary Space Technology.										
	PE 0602601F, Space Technology. PE 0602702F, Command, Control, and Communications.										
Pro	ject 2311				R-1 Line Item No Page-46 of 60 46					Exhibit R-2a (F	PE 0601102F)

	UNCLASSIFIED	
Exhibit R-2a, RDT&	E Project Justification	DATE February 2007
BUDGET ACTIVITY D1 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2311 Information Sciences
<ul> <li>U) <u>C. Other Program Funding Summary (\$ in Millions)</u></li> <li>U) PE 0603410F, Space System Environmental Interactions Technology.</li> <li>U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology. This project has been coordinated through the Reliance 21 process</li> <li>U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	s to harmonize efforts and eliminate duplication.	
Project 2311	R-1 Line Item No. 1 Page-47 of 60 47	Exhibit R-2a (PE 0601102F

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY Isic Research					IBER AND TITL 02F Defense ces			OJECT NUMBE		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2312	Biological Sciences	9.486	10.014	10.396	10.295	12.153	11.516	12.113	12.927	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
e ( T i t t t t c c	nduced by chemical and physical age exploit biological properties to contro- lasers and microwaves) with human to naterials and directed energy systems in biomimetic sensors strives to mimic biocatalysis characterizes and bioengi he mimicking of natural materials, us or taking existing biomaterials/organis biomineralization. Research in biointer either the biotic-biotic or the biotic-ab could be used to either harden or repa- biologically based systems, either with	and manipula issues and ass , and innovation the biological neers cellular ing organisms sms and using erfacial science iotic interface in bio-based de	ate operational ociated effects on of biotechn l detection sys enzymes to bio as biomateria them as novel e is focused on . Research in b evices or can u	environment to enable saf ologies to enh stems of organ osynthesize re l factories of n materials like new biosense biophysical m tilize comple:	s. Research top ety assessmen hance the phys hisms at the mo- enewable hydro- new materials, e viral gradien ors and bionan echanisms wil x, impure biof	pics are focuse t strategies, ha iological perfe olecular level ogen fuel from genetically al ts or processir otechnology, l look to disco uels for compa	ed on the inter- izard-free dev ormance and p in developing a sunlight and tering existing g them furthe and specifical over and under- act power. This	actions of che elopment and protection of A novel man-ma water. Resear g organisms for r to make a us ly addresses the rstand basic bi-	micals and ph use of future a ir Force perso ade sensors. E ch in biomate or new material eful material he fundamenta ological mech	ysical agents air and space onnel. Research rials focuses of als capabilitie as in al science at anisms that	in on
(U) 1 (U) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Characterize, und induced in organisms by chemical and synthetic jet fuels, nano-energetic ma novel enzymatic properties that enabl generation of hydrogen fuel from wat involved in the positive stimulatory (n low-doses of toxic agents and investig inducing a protective state in tissue the In FY 2006: Refined biokinetics mod dermal and pulmonary exposures to f the biomolecular responses induced b with biological systems. Utilized bio photosynthetic microbes to generate f	ram (\$ in Mill derstand, predi- d physical age terials, and dir e photosynthe er. Explore bio rather than the gate the implic at is resistant els used to pre uel mixtures. y the interaction catalysis techri	tions) ict, control, an ints of Air Force ected energy. tic microbes to prolecular pro- negative inhibit ations of such to subsequent dict the fuel co Applied metho- pons of directed iques for use in	d engineer bio ce significance Identify, char o use light ene offiles and horn oitory) biologi low-dose pos high-dose tox onstituent leve odologies for l energy and r n genetically	omolecular res e, such as alter acterize, and e ergy for the rer metic mechani ical responses sitive stimulati icity. els in tissues fo profiling and r nano-energetic engineering	ponses nate ngineer newable sms induced by on in ollowing nodeling materials	<u>FY 20</u> 5.3		<u>7 2007</u> 5.724	<u>FY 2008</u> 5.872	<u>FY 2009</u> 5.836
Proje	ct 2312				I Line Item No. 1 Page-48 of 60 48	I				Exhibit R-2a (F	PE 0601102F)

	Exhibit R-2a, RDT&E Project Just	tification		DATE	February	2007
	GET ACTIVITY asic Research	PE NUMBER AND TITLE 0601102F Defense Res Sciences	search	PROJECT NUME 2312 Biologie		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> kinetics associated with the positive stimulatory or "hormetic" responses of biologica to very low-levels of known toxic substances and hazardous radiation.	al systems exposed	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	In FY 2007: Experimentally validate biokinetics models used to predict the fuel const tissues following dermal and pulmonary exposures to fuel mixtures. Continue profili the biomolecular responses induced by the interactions of directed energy and nano with biological systems. Continue utilizing biocatalysis techniques and genetic engir elicit the water-based generation of fuel-cell hydrogen by photosynthetic microbes. I biomolecular profiles for underlying mechanisms associated with positive stimulator responses of biological systems exposed to very low-levels of known toxic substance radiation.	ing and modeling energetic materials neering principles to Investigate the ry or "hormetic"				
	In FY 2008: Refine whole animal biokinetic models predicting tissue disposition of based on iterative experimental input derived from laboratory animal exposures and apply newly developed methodologies to acquire in vitro and in vivo data from biolo exposed to nano-scale structures possessing varying physical and chemical propertie improved methodologies, begin the molecular profiling and characterization of biolo responding to high and low doses of directed energy generated from laser and micro Continue bio-prospecting for hydrogen-generating microbes and begin bio-engineerid directed-evolution experiments aimed at enhancing the photosynthetic flow of electric the hydrogen-generating enzyme. Continue to acquire genomic profiling data from v non-hormetic response segments of radiation-exposed cells and begin bioinformatics specific genes or gene fingerprints that suggest a uniquely hormetic response.	analyses. Begin to ogical systems s. By using recently ogical systems wave sources. ing and ons and protons to various hormetic and				
(U)	In FY 2009: Begin to integrate individual computational models characterizing multi deposition in lung and absorption through skin into animal biokinetic models for pre animal disposition of single fuel components. Continue to collect data from biologic to nano-materials and begin to develop a data base of responses for future predictive based on physico-chemical properties of various nanostructures. Continue collecting dose-response data and begin bioinformatics analyses to identify unique biomolecula responding to specific levels of radiant exposure. Continue bio-prospecting, bio-engi directed-evolution approaches to the generation of hydrogen fuel by photosynthetic r metabolic engineering research to identify and eliminate pathways that drain unnece equivalents away from the hydrogen-generating apparatus. Continue genomic profili	dicting whole al systems exposed modeling studies directed energy ar profiles ineering and microbes and begin ssary energy				
Proj	ect 2312 Page-	Item No. 1 49 of 60 <b>49</b>			Exhibit R-2a (P	PE 0601102F)

Exhibit R-2a, RDT&E	DATI	DATE February 2007				
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Sciences			UMBER AND TITLE ogical Sciences		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> bioinformatics analysis of hormetic and non-hormetic dose-respon comparative proteomics to validate any mechanistic conclusions d	•	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Explore biomimetics, biomaterials, and bioint development of novel sensors, engineering processes, and mechan materials, as well as to research new sensor modalities, explore surextreme environmental conditions. Research in biophysical mechan understand basic biological mechanisms that could be used to either or can utilize complex, impure biofuels for compact power.</li> </ul>	erfacial sciences to enable sms, and the synthesis of novel face-mediated process, and delve into hisms will look to discover and	4.107	4.290	4.524	4.459	
<ul> <li>(U) In FY 2006: Investigated, evaluated, modeled, and mimicked biolo applications in near ambient temperature sensing devices. Probed a biophotoluminescent characteristics in microbial and protein-based military sensor systems. Exploited biomaterial and biointerfacial s evaluate biosensors, and elucidate bionanotechnology applications</li> </ul>	nd manipulated biochromophores and biosystems for applications to siences to synthesize novel materials,					
<ul> <li>(U) In FY 2007: Phase out investigating, evaluating, modeling, and middesigns for future applications in near ambient temperature sensing and new prey detection schemes as future technology areas. Further biochromophores and biophotoluminescent characteristics in micro applications to military sensor systems. Continue to exploit bioma control cellular systems to synthesize novel materials, evaluate bio bionanotechnology applications. Research surface mediated cellular modality. Expand into extremophile research to access biosyntheti temperature organisms.</li> </ul>	micking biological processes and g devices, and add predator avoidance r probe and manipulate obial and protein-based biosystems for erial and biointerfacial sciences to sensors, and elucidate ar differentiation as a new sensor					
(U) In FY 2008: Initiate work on manipulating materials to mimic the maintenance, self-healing, and repair. Continue to investigate pred detection schemes as future technology areas. Further probe and m biophotoluminescent characteristics in microbial and protein-based military sensor systems. Continue to exploit biomaterial and bioint systems to synthesize novel materials, evaluate biosensors, and elu applications. Research surface mediated cellular differentiation as investigations in extremophile research to access biosynthetic path	ator avoidance and new prey anipulate biochromophores and biosystems for applications to erfacial sciences to control cellular cidate bionanotechnology a new sensor modality. Continue					
Project 2312	R-1 Line Item No. 1 Page-50 of 60			Exhibit R-2a (I		

		Exhibit	: R-2a, RD <sup>-</sup>	T&E Projec	ct Justifica	tion			DATE	February	2007
BUDGET / 01 Basic	ACTIVITY c Research				060 <sup>-</sup>	UMBER AND TI 1102F Defens Pinces			ROJECT NUMBE		
wit und	Accomplishments/Planned h room temperature organism lerstand the basic underlying -based devices or can utilize	ns. Continue wo	ork in biophysi hanism that co	ould be used to	either harden o		<u>FY 2</u>	<u>006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In F for dete bio mil sys: app inve wit und bio	FY 2009: Continue work on maintenance, self-healing an ection schemes as future tech photoluminescent characteris itary sensor systems. Continu- tems to synthesize novel mate dications. Research surface re estigations in extremophile r h room temperature organism lerstand the basic underlying -based devices or can utilize	manipulating n nd repair. Contin mology areas. F stics in microbia ue to exploit bio terials, evaluate nediated cellula esearch to access ns. Continue w biological mec	haterials to min nue to investig Further probe a al and protein- omaterial and b biosensors, an r differentiation ss biosynthetic ork in biophys hanism that co	nic the desirab ate predator av nd manipulate based biosyste biointerfacial s id elucidate bio n as a new ser pathways and ical mechanisi uld be used to	ble properties for voidance and ne biochromopho ms for applicat ciences to contro- phonotechnolog noor modality. Of materials not a ms to discover a either harden of	w prey res and ions to rol cellular Sy Continue achievable and		497	10.014	10.207	10 205
	al Cost <b>)ther Program Funding Su</b>		<b>A:Ili</b> ona)				9.	486	10.014	10.396	10.295
<ul> <li>(U) Rela</li> <li>(U) PE ( Effe Reso</li> <li>(U) PE ( Sena</li> <li>(U) PE ( Mun</li> <li>(U) PE ( Con</li> </ul>	ated Activities: D602202F, Human ectiveness Applied earch. D602204F, Aerospace sors. D602602F, Conventional nitions. D602702F, Command, ttrol, and Communication. s project has been coordinate	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	Cost to Complete	Total Cost
Project 2	312				R-1 Line Item No Page-51 of 60 51					Exhibit R-2a (F	PE 0601102F)

Exhibit R-2a, RDT8	<b>&amp;E Project Justification</b>	DATE February 2007
JDGET ACTIVITY I Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2312 Biological Sciences
J) <u><b>D. Acquisition Strategy</b></u> Not Applicable.		
Project 2312	R-1 Line Item No. 1 Page-52 of 60	Exhibit R-2a (PE 0601102

	CResearch       0601102F Defense Research Sciences       2313 Human Performance         Cost (\$ in Millions)       FY 2006 Actual       FY 2007 Estimate       FY 2009 Estimate       FY 2010 Estimate       FY 2011 Estimate       FY 2012 Estimate       FY 2013 Estimate       Cost to Complete       Total         Human Performance       13.402       12.556       11.120       11.254       16.255       13.945       12.424       12.715       Continuing       TBD         Quantity of RDT&E Articles       0       <											
	ET ACTIVITY asic Research				06011	02F Defense					•	
	Cost (\$ in Millions)										Total	
2313										Continuing	TBD	
			Ů	0	0	0	0	0	0			
	Force operations. The goal is to devel the flexible adaptation of Air Force sy sensory, biophysical, or cognitive wor research topics focus investigations or and fused-image displays, and adaptiv performance due to jet lag, shift work	op useful quar stems to meet kloads. Senso h developing A ve systems for , night operation	titative model new adversar ry research en Air Force techn operator and t ons, and the lo	s of the way a ial challenges ophasizes visu nologies inclu eam training. ss of life and	Air Force warf ; make decisio al, auditory, ed ding specialize Novel strategi for aircraft due	ighters perceiv ns in complex quilibrium, an ed interactive of es to maintain to stress, inat	ve, appraise, a tasks under s d kinesthetic s displays, simu decisive awa tention, or lac	nd manipulate tress or uncert systems and th lators, intellig reness by prev k of vigilance	e their environ ainty; and ada eir optimal in ent control sy enting impair are being eva	ment, includin apt to extreme tegration. Bas stems, sensors ed operating luated. The	ng sic s	
(U)	MAJOR THRUST: Probe human ser	nsory systems sensory integr rce weapon sy	and perception ation, and sen stems. Researc	sory biomime ch biophysica	tics) to enhance 1 and neural m	e echanisms						
(U)	In FY 2006: Conducted empirical res- audition, speech perception, and hear and novel biological sensing mechani Evaluated models of sleep/wake dyna individual warfighter. Studied the effo	ing protection. sms. Probed b unics to predic ects of ultrashe	Further asses iophysical me of specific cons ort laser pulse	sed multi-sens chanisms resp sequences in t on the eye (la	sory integratio consible for fat the performance user flash blind	n methods igue. e of an ness).						
	In FY 2007: Continue empirical resea audition, speech perception, and hear novel biological sensing mechanisms fatigue. Further evaluate models of sl performance of an individual warfigh the eye (laser flash blindness).	ing protection. . Continue to p eep/wake dyna	Exploit multi probe biophysi amics to predic	-sensory integ cal mechanist ct specific cor	gration method ms responsible nsequences in t	s and for he						
(U)	In FY 2008: Continue empirical rese	arch with matl	nematical and	computationa	l modeling in	spatial						
Proie	ect 2313				1 Line Item No. 1 Page-53 of 60					Exhibit R-2a (P	E 0601102F)	
					53					(	/	

Exhibit R-2a, RDT&E	Project Justification		DATI	February	2007	
BUDGET ACTIVITY <b>01 Basic Research</b>	PE NUMBER AND TITLE 0601102F Defense I Sciences			MBER AND TITLE	R AND TITLE	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> audition, speech perception, and hearing protection. Prepare new un and acoustic noise for transition to hearing protection technologies. methods and novel biological sensing mechanisms. Continue to pro- responsible for fatigue, including models of sleep/wake dynamics. Is sleep deprivation, to predict specific consequences in the performan models showing effects of ultrashort laser pulse on the eye (laser flater)	Exploit multi-sensory integration be biophysical mechanisms Shift emphasis from acute to chronic nee of individual warfighters. Refine ash blindness).	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U) In FY 2009: Continue empirical research with mathematical and conaudition, speech perception, and hearing protection for improved team communication, and hearing conservation. Begin to transition and novel biological sensing mechanisms. Continue to probe biophy fatigue. Continue shifting emphasis from acute to chronic sleep depichanges in individual warfighters. Continue refining models of ultraflash blindness).</li> </ul>	chnologies in speech recognition, a multi-sensory integration methods ysical mechanisms responsible for rivation, to quantify performance					
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Evaluate cognition and perception research to r human performance in complex, multi-interaction command and co and physiological theories of cognitive workload, alertness, and vul dynamic models of attitudes and beliefs that drive adaptive decision non-cooperative groups.</li> </ul>	ntrol tasks. Investigate behavioral nerability to sleep loss. Discover	5.051	5.358	5.720	6.001	
(U) In FY 2006: Developed quantitative models and methods for improvied team information processing and decision making. Assessed mechan for individuals and teams. Continued modeling relationships between interactions with envisioned training. Continued to explore measure optimize decision making under conditions of uncertainty and information.	nisms affecting training effectiveness en individual skill differences and es to avert/mitigate human error and					
(U) In FY 2007: Refine quantitative models of individual and team infor decision-making including applications to systems to improve the sp teams. Employ progress on modeling individual and team training for systems optimized for specific individuals, teams, and applications. learning and automated, diagnostic mentoring of individuals. Develo spatial-imaginal processing. Continue exploring measures to avert/m decision making under conditions of uncertainty and information over the spatial systems.	rmation processing and peed and accuracy of networked for the development of training Assess mechanisms for continuous op models of symbolic nitigate human error and optimize					
Project 2313	R-1 Line Item No. 1 Page-54 of 60			Exhibit R-2a (	DE 0601102E)	

	Exhibit R-2a, RDT&E Project	t Justification		DAT	DATE February 2007			
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Sciences			MBER AND TITLE n Performance			
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2008: Continue to refine quantitative models of individual and team in decision-making for application to systems for improving speed and accuracy teams. Employ progress on modeling individual and team training for the dev systems optimized for specific individuals, teams, and applications. Assess m learning and automated, diagnostic mentoring of individuals to enable human collaboration. Continue exploring measures to avert/mitigate human error and under conditions of uncertainty and information overload. Increase cognitive include socio-cultural influences in competitive or non-cooperative environm response to and prediction of adversary actions.	y of decisions networked relopment of training echanisms for continuous and machine d optimize decision making process modeling to	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	In FY 2009: Continue to refine quantitative models of individual and team in decision-making for application to systems for improving the speed and accur networked teams. Employ progress on modeling individual and team training training systems optimized for specific individuals, teams, and applications. A continuous learning and automated, diagnostic mentoring of individuals to en machine collaboration. Continue exploring measures to avert/mitigate human decision making under conditions of uncertainty and information overload. C modeling, including agent-based modeling and game theory, to include socio-competitive or non-cooperative environments for successful airmen response adversary actions.	racy of decisions in for the development of Assess mechanisms for able true human and error and optimize ontinue cognitive process -cultural influences in						
(U) (U)	CONGRESSIONAL ADD: Virtual Teleoperations for Unmanned Aerial Vel In FY 2006: Supported university research team that is designing, developing testing the hardware, software, and aeronautical systems necessary to create in stations based on virtual reality technology. In FY 2007: Continue research on virtual reality technology to allow a single simultaneously monitor and control multiple unmanned aerial vehicles remote In FY 2008: Not Applicable.	g, implementing, and mmersive ground control e operator to	3.378	1.755	0.000	0.000		
(U)	In FY 2009: Not Applicable. Total Cost		13.402	12.556	11.120	11.254		
Proj	ect 2313	R-1 Line Item No. 1 Page-55 of 60 55			Exhibit R-2a (f	PE 0601102F)		

	Exhibi	t R-2a, RD <sup>-</sup>	F&E Projec	ct Justifica	tion			DATE	February 2007
BUDGET ACTIVITY 01 Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences			PROJECT NUMBER AND TITLE 2313 Human Performance		
(U) <u>C. Other Program Funding Su</u>						EN 2011	EV 2012		
	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u> <u>Total Cost</u>
(U) Related Activities:									<u></u>
(U) PE 0602202F, Human Effectiveness Applied									
Research. (U) PE 0602702F, Command,									
Control, and Communication. This project has been coordinate	d through the F	Reliance 21 pro	cess to harmor	nize efforts and	eliminate dup	lication.			
(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.	C								
				R-1 Line Item No					
Project 2313				Page-56 of 60	J				Exhibit R-2a (PE 0601102F)

		Exhibit R-	2a, RDT&I	E Project .	Justificatio	on			DATE	February 2	2007
BUDGET ACTIVIT 01 Basic Rese						IBER AND TITL 02F Defense Ces		41	OJECT NUMBE 13 External terface	R AND TITLE Research P	rograms
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4113 Externa Interfac	ll Research Programs	8.434	8.663	12.019	12.414	13.576	13.119	13.837	14.703	Continuing	TBD
Quantit	y of RDT&E Articles	0	0	0	0	0	0	0	0		
The primar support and scientific a and attract relationship	Description and Budget y elements in this project a d develop scientists and engind engineering education b talented scientists and engine os with future coalition par- titutions, and other minorit	are to facilitate gineers with an peneficial to the ineers to addre tners. This pro	interactions b awareness of Air Force, in ss Air Force n	Air Force bas crease the aw eeds. Internat	sic research pr areness of Air ional interaction	iorities. These Force basic roons facilitate f	e professional esearch priorit uture interope	interactions an ies to the rese rability of coa	nd collaboratio arch commun llition systems	ons stimulate ity as a whole, and foster	
(U) MAJOR T Force's internation	plishments/Planned Prog HRUST: Foster internation ernational strategy mission tional technology liaison m ent and the Asian Office of	nal science and . Identify and on dissions of the	l technology c obtain unique European Offi	foreign resear	ch capabilities	through	<u>FY 20</u> 4.3	_	<u>Y 2007</u> 4.503	<u>FY 2008</u> 4.795	<u>FY 2009</u> 5.096
(U) In FY 2000 missions in Capitalized Established research ca interface to	5: Provided centralized coon order to identify and main of on foreign investments by and maintained access to apabilities. Supported interno- coordinate international p nts to NATO-affiliated reso	operation expe ntain awarenes y influencing a technical brief national visits participation an	rtise and supp s of foreign sc nd acquiring v s and publicat of high-level I nong DoD org	orted internation ience and tech vorld-class sci ions on uniqu DoD delegation	hnology devel- ientific researce ie foreign researce ons and provid	opments. ch. arch and ed primary					
(U) In FY 200' liaison mis developme scientific r foreign res delegation organizatio	7: Continue to provide cen asions in order to identify a cents. Continue to capitalize esearch. Continue to seek a earch and research capability and provide primary inter ons. Continue to assist in A 8: Continue to provide cen	tralized coope nd maintain av on foreign inv and maintain av ities. Continue rface to coordin ir Force fiscal	ration expertis vareness of for estments by ir ccess to techni to support int nate internatio commitments	reign science a offluencing and ical briefs and ernational vis nal participati to NATO-aff	and technolog d acquiring wo publications its of high-lev ion among Do iliated researc	y orld-class on unique el DoD D h institutes.					
(U) In FY 2005 Project 4113	5. Continue to provide cen			R-1	Line Item No. 1 Page-57 of 60 57					Exhibit R-2a (P	E 0601102F)

	Exhibit R-2a, RDT&E Proj	ect Justification		DATE	E February	2007		
BUDGET ACTIVITY 01 Basic Research		PE NUMBER AND TITLE 0601102F Defense R Sciences	0601102F Defense Research			UMBER AND TITLE Frnal Research Programs		
<ul> <li>(U) <u>B. Accomplishmer</u> liaison missions in developments. Cor scientific research. foreign research an delegations and pro organizations. Con</li> <li>(U) In FY 2009: Conti liaison missions in developments. Cor scientific research. foreign research an delegations and pro</li> </ul>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>					
<ul> <li>(U)</li> <li>(U) MAJOR THRUST infrastructure in the continuing availabit</li> </ul>	Attinue to assist in Air Force fiscal commitments to NAT Strengthen science, mathematics, and engineering res- e U.S., thereby strengthening Air Force technical capab- ility of superior technical talent and forge Air Force Re- premiere scientists. Note: Increased funding in FY 200 sory Board efforts.	search and educational pilities. Assure the Air Force of search Laboratory	4.041	4.160	7.224	7.318		
including historica institutions. Enhan	orted scientist and engineering research programs at U. Ily black colleges and universities, Hispanic serving ins aced awareness of Air Force research needs throughout of sly identifying/recruiting the best scientific talent to par	stitutions, and other minority civilian scientific community,						
(U) In FY 2007: Conti outreach programs universities, Hispa Force research nee	inue to support science, mathematics, and engineering r a tU.S. colleges and universities, including historically nic serving institutions, and other minority institutions. eds throughout civilian scientific community, while simu- ing the best scientific talent to participate in critical Air	black colleges and Increase awareness of Air ultaneously						
(U) In FY 2008: Conti	inue to support science, mathematics, and engineering r at U.S. colleges and universities, including historically	esearch and educational black colleges and						
Project 4113		R-1 Line Item No. 1						

		Exhibit	: R-2a, RD1	ſ&E Projec	t Justifica	tion			DATE	February	2007	
	GET ACTIVITY Basic Research				<b>060</b> 1	UMBER AND TI 102F Defens nces			DJECT NUMBER AND TITLE 13 External Research Programs erface			
(U)	<b>B.</b> Accomplishments/Planne	d Program (\$ in	<u>Millions)</u>				<u>FY 20</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	outreach programs at U.S. col universities, Hispanic serving	but civilian scient scientific talent to port science, math leges and univers institutions, and	ific community o participate in mematics, and e ities, including other minority	y, while simult critical Air Fo ngineering reso historically bl institutions. In	aneously orce research. earch and educ: ack colleges ar crease awarene	ational 1d						
	Force research needs through identifying/recruiting the best		•		•							
(U)		scientific talent b	o participate in		nce research.		8.4	134	8.663	12.019	12.414	
(U)	C. Other Program Funding	<u>Summary (\$ in N</u>	<u>(fillions)</u>									
		FY 2006 Actual	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> Estimate	FY 2009 Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> <u>Estimat</u>		<u>Cost to</u> <u>Complete</u>	Total Cost	
(U)	Related Activities:											
(U)	PE 0601103D, University											
	Research Initiative.											
	PE 0602102F, Materials.											
(U)	PE 0602201F, Aerospace											
ДD	Flight Dynamics.											
(U)	PE 0602202F, Human Effectiveness Applied											
	Research.											
an	PE 0602203F, Aerospace											
(0)	Propulsion.											
(U)	PE 0602204F, Aerospace											
	Avionics.											
(U)	PE 0602269F, Hypersonic											
	Technology Program.											
(U)	PE 0602500F,											
	Multi-Disciplinary Space											
ДÞ	Technology. PE 0602601F, Space											
$(\mathbf{U})$	re 0002001r, Space				R-1 Line Item No	. 1						
1	oject 4113				Page-59 of 60						PE 0601102F)	

	UNCLASSIFIED	
Exhibit R-2a, RDT&E	Project Justification	DATE February 2007
UDGET ACTIVITY 1 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 4113 External Research Programs Interface
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
<ul> <li>Technology.</li> <li>U) PE 0602602F, Conventional Munitions.</li> <li>U) PE 0602702F, Command, Control and Communication. This project has been coordinated through the Reliance 21 process in</li> </ul>	to harmonize efforts and eliminate duplication.	
U) <b>D. Acquisition Strategy</b> Not Applicable.		
Project 4113	R-1 Line Item No. 1 Page-60 of 60	Exhibit R-2a (PE 0601102

#### PE NUMBER: 0601103F PE TITLE: University Research Initiatives

	Exhibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
UDGET ACTIVITY 11 Basic Research					BER AND TITL <b>)3F Univers</b>	E ity Research	Initiatives			
	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Cost (\$ in Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Co	st 105.698	115.035	104.304	101.850	124.004	124.444	120.867	123.151	Continuing	TB
5094 University Research Initiatives	105.698	115.035	104.304	101.850	124.004	124.444	120.867	123.151	Continuing	TB
U) <u>A. Mission Description and Budg</u> This program supports defense-rela superiority; enhances and promotes technologies; and assists universitie fundamental component of this pro- interdisciplinary efforts. Note: In F for High Temperature Hydrogen Er Activity 1, Basic Science, because it	ed basic researc the education of s in establishing gram is the recog Y 2007, Congre ergy Production	h in a wide rar U.S. scientists superior instru- nition that fut ss added \$4M , and \$1.1M for	s and engineer imentation cap ure technologi for Single Chi or Partnership	rs in discipline pabilities need ies and techno ip Multi-Moda in Innovative	es critical to m led to improve logy exploitat ll Nanosensor	aintaining, ad the quality of ions require hi s, \$1.8M for H	vancing, and e defense-relat ghly coordina ligh Assuranc	enabling future ed research an ated and conce e Software En	e U.S. defense d education. A rted multi- an gineering, \$11	A d
U) <u>B. Program Change Summary (</u> \$										
					<u>FY 20</u>		<u>FY 2007</u>		2008	<u>FY 2009</u>
U) Previous President's Budget					108.7		107.571		7.931	117.225
U) Current PBR/President's Budget					105.6		115.035	104	4.304	101.850
U) Total Adjustments					-3.0	59				
U) Congressional Program Reductions					0.0		0.426			
Congressional Rescissions					-0.0	03	-0.436			
Congressional Increases							7.900			
Reprogrammings					2.0					
SBIR/STTR Transfer					-3.0	56				
U) <u>Significant Program Changes:</u>										
Not Applicable.										
C. Performance Metrics										
(U) Under Development.										
-										
			R-1	Line Item No. 2 Page-1 of 6					Exhibit R-2 (Pl	<u>E 0601103</u> F
				61						
			UN	CLASSIFIE	D					

	Initiatives       6094 University Research Initiatives         Cost (\$ in Millions)       FY 2006       FY 2009       FY 2010       FY 2011       FY 2012       FY 2013       Cost (\$ in Millions)       Actual       Estimate       Estimate <th colspan<="" th=""></th>													
	ET ACTIVITY asic Research				06011	03F Univers					Initiatives			
	Cost (\$ in Millions)	FY 2006									Total			
<b>7</b> 00 (									1	<u> </u>				
5094										Continuing	TBD			
(U) <u>4</u>				0	0	0	0	0	0					
s t f i f	superiority; enhances and promotes the technologies; and assists universities is fundamental component of this progra interdisciplinary efforts. Note: In FY for High Temperature Hydrogen Energy	e education of n establishing im is the recog 2007, Congres gy Production	U.S. scientist superior instru- gnition that fut ss added \$4M , and \$1.1M for	s and enginee umentation ca ure technolog for Single Ch or Partnership	rs in discipline pabilities need ies and techno ip Multi-Moda in Innovative	es critical to m led to improve logy exploitat al Nanosensor	aintaining, ad the quality of ions require h s, \$1.8M for H	vancing, and f defense-relation ighly coordination ligh Assurance	enabling futur ted research ar ated and conce ce Software En	e U.S. defense nd education. erted multi- an ngineering, \$1	A nd			
(U) (U)	MAJOR THRUST: Promote fundam projects. Topics will be selected in so technologies, such as nanotechnology and structures, efficient energy and po and enhancing human performance. In FY 2006: Funded competitive rese	ental, multi- a cientific resear , sensor netwo ower conversio arch awards at	nd interdiscipl ch areas relate orks, intelligen on, high energ	d to transform ce informatio y materials for ties to focus o	national and hi n fusion, smar r propulsion a on underpinnin	igh priority t materials nd control, g Air								
(U)	and recognized superior academic res and Engineers (PECASE). Continued In FY 2007: Continue to fund compet Air Force-related technologies usually Continue to support and recognize sup through PECASE. Continue funding of	earch through funding of mu itive research y not achievab perior academ	the Presidenti alti-disciplinar awards at U.S le through typ ic researchers	al Early Caree y programs be universities ical single inv in the early st	er Award for S egun in prior y to focus on un vestigator awar ages of their c	Scientists years. derpinning rds.								
(U) (U)	In FY 2008: Continue funding compe Air Force-related technologies usually Continue to support and recognize sup through PECASE. Continue funding compe Air Force-related technologies usually	titive research y not achievab perior academ of multi-discip titive research	awards at U.S le through typ ic researchers linary program awards at U.S	S. universities ical single inv in the early st as begun in pr S. universities	to focus on un vestigator awar rages of their c rior years. to focus on un	rds. areer nderpinning								
Proje	ect 5094			R-1	1 Line Item No. 2 Page-2 of 6 62	2				Exhibit R-2a (P	PE 0601103F)			

	Exhibit R-2a, RDT&E Project Ju	ustification		DATI	February	2007
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601103F University Initiatives	y Research	PROJECT NUM 5094 Unive		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> Support and recognize superior academic research through the Presidential Early Scientists and Engineers (PECASE). Continue funding of multi-disciplinary progyears.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Support post-graduate, graduate, and undergraduate education engineering disciplines at U.S. universities. National Defense Science and Engin Program (NDSEG) Fellowships are awarded to train U.S citizens in science and e of military importance under a joint tri-Service and Office of the Director of Defe Engineering competition.	eering Graduate engineering disciplines	35.077	37.650	36.325	35.470
(U)	In FY 2006: Awarded highly competitive NDSEG fellowships. Supported compe- graduate and undergraduate research experiences including those established und Stimulate and Support Undergraduate Research Education program. Continued to under prior year Department of Defense programs.	er the Awards to				
(U)	In FY 2007: Continue to award highly competitive NDSEG fellowships. Continu competitive awards for graduate and undergraduate research experiences includin under the Awards to Stimulate and Support Undergraduate Research Education p funding for awards made under prior year Department of Defense programs.	ng those established				
(U)		ng those established				
(U)		ng those established				
(U)						
(U)	MAJOR THRUST: Enhance the scientific and engineering research and education instrumentation at U.S. universities.	on infrastructure and	14.630	15.500	11.636	11.433
(U)	In FY 2006: Conducted the competition for U.S. universities to acquire state-of-tinstrumentation and infrastructure to enhance research and educational capabilities. University Research Instrumentation Program.	• • •				
		ine Item No. 2 Page-3 of 6			Exhibit R-2a (I	

	Exhibit R-2a, RDT&E Projec	t Justification		DATE	DATE February 2007			
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601103F Universit Initiatives			BER AND TITLE			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2007: Continue to conduct the competition for U.S. universities to acquitechnology instrumentation and infrastructure to enhance research and educate Defense University Research Instrumentation Program.							
(U)	In FY 2008: Continue to conduct the competition for U.S. universities to acq technology instrumentation and infrastructure to enhance research and educar Defense University Research Instrumentation Program.	•						
(U)	In FY 2009: Continue to conduct the competition for U.S. universities to acquitechnology instrumentation and infrastructure to enhance research and educate Defense University Research Instrumentation Program.	-						
(U)								
(U) (U)	CONGRESSIONAL ADD: 21st Century Information Operations Workforce In FY 2006: Supported an Information Operations curriculum to educate grad		1.054	0.000	0.000	0.000		
(U)	in the field of intelligence. In FY 2007: Not Applicable.							
(U)	In FY 2008: Not Applicable.							
(U)	In FY 2009: Not Applicable.							
(U)								
(U)	CONGRESSIONAL ADD: Bio/Nano Electronic Devices and Sensors		1.437	0.000	0.000	0.000		
(U)	In FY 2006: Developed and demonstrated a prototype 3-D magnetic memory capabilities and a high data transfer rate on an erasable medium and also to d transferring information on the surface of photosensitive proteins at the single	etermine the feasibility of						
(U)	In FY 2007: Not Applicable							
(U)	In FY 2008: Not Applicable							
(U)	In FY 2009: Not Applicable							
(U)								
(U)	CONGRESSIONAL ADD: High Assurance Software Engineering		1.629	1.743	0.000	0.000		
(U)	In FY 2006: Conducted research in the security issues in information techno components. (Note: In FY 2006, it was called Secure and Assured Information)							
	In FY 2007: Continue research to develop software for information security							
	In FY 2008: Not Applicable							
(U)	In FY 2009: Not Applicable							
Pro	ject 5094	R-1 Line Item No. 2 Page-4 of 6			Exhibit R-2a (I	PE 0601103F)		

	Exhibit R-2a, RDT&E Project	DAT	DATE February 2007				
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601103F Universit Initiatives			MBER AND TITLE		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	CONGRESSIONAL ADD: Military Logistics Readiness		0.958	0.000	0.000	0.000	
(U)	In FY 2006: Supported the Air Force crew systems personnel protection progr	am	0.750	0.000	0.000	0.000	
` '	In FY 2007: Not Applicable.						
· /	In FY 2008: Not Applicable						
	In FY 2009: Not Applicable						
(U)							
(U)	CONGRESSIONAL ADD: Partnership in Innovative Preparation for Educator FY06, this add was in PE 61102F BPAC 2311 and called Network Information		0.000	1.065	0.000	0.000	
(U)	In FY 2006: Not Applicable						
(U)	In FY 2007: Conduct multi-disciplinary research associated with information in	network for educators and					
	students						
U)	In FY 2008: Not Applicable						
(U)	In FY 2009: Not Applicable						
(U)							
	CONGRESSIONAL ADD: Single Chip Multi-Modal Nanosensors		0.000	3.873	0.000	0.000	
	In FY 2006: Not Applicable						
(U)	In FY 2007: Conduct research to develop single chip sensors for the detection of	of chemical and					
	biological agents						
	In FY 2008: Not Applicable						
	In FY 2009: Not Applicable						
(U)							
	CONGRESSIONAL ADD: High Temperature Hydrogen Energy Production		0.000	0.968	0.000	0.000	
	In FY 2006: Not Applicable						
	In FY 2007: Conduct research to develop methods for hydrogen production						
	In FY 2008: Not Applicable						
	In FY 2009: Not Applicable						
(U)	Total Cost		105.698	115.035	104.304	101.850	
Proi	ect 5094	1 Line Item No. 2 Page-5 of 6			Exhibit R-2a (	PF 0601103F	

	Exhibit	R-2a, RD	F&E Projec	ct Justifica	tion			DATE	February 2007
BUDGET ACTIVITY 01 Basic Research				060	UMBER AND TI <sup>-</sup> I 103F Univer atives	TLE rsity Researd		ROJECT NUMBE <b>)94 Universit</b>	R AND TITLE y Research Initiatives
<ul> <li>(U) <u>C. Other Program Funding Sur</u></li> <li>(U) Related Activities:</li> <li>(U) PE 0601102F, Defense Research Sciences This project has been coordinated</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u> eliminate dupl	FY 2011 Estimate	FY 2012 Estimate	<u>FY 2013</u> Estimate	Complete Total Cost
Project 5094				R-1 Line Item No Page-6 of 6 66	o. 2				Exhibit R-2a (PE 0601103F)

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

	chibit R-2,	RDT&E B	udget Item					DATE	February 2	2007
DGET ACTIVITY Basic Research					BER AND TITL <b>)8F High En</b>	<sub>E</sub> ergy Laser F	Research In	itiatives		
Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Cost (\$ III MIIIIOIIS)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cost	12.072	12.356	12.636	13.735	14.079	14.299	14.581	14.883	Continuing	TB
)97 High Energy Laser Research Initiatves	12.072	12.356	12.636	13.735	14.079	14.299	14.581	14.883	Continuing	TB
A. Mission Description and Budget This program funds basic research aim systems. HEL systems have many pot logistics requirements. As a result, HI defeat of high-speed, maneuvering ant program is part of an overall DoD effec program are chosen for their potential are directed at more specific Service n propagation, and free electron lasers. Research, because it funds scientific si understanding in those fields of science	ned at develop tential advanta ELs have the p ti-ship and ant ort in HEL scie to have a broad eeds. A broad The program to tudy and expension	ing fundament ges, including potential to per i-aircraft missi ence and techn id impact on n l range of tech funds theoretic rimentation. T	speed-of-ligh form a wide v les; and ultra- ology conduc nultiple HEL s nologies are a cal, computatio 'hrough this p	at velocity, hig variety of milit precision nega- ted by the HE systems and Se addressed in ke onal, and expe rogram, the D	h precision, si ary missions i ation of targets L Joint Techno ervice mission ey areas such a rimental inves oD invests in	gnificant mag ncluding inter s in urban envi ology Office. s, while comp as chemical las stigations. Thi	azine depth, le ception of bal ironments wit In general, ef lementing Ser sers, solid stat is program is	ow-cost per ki listic missiles h no collateral forts funded u vice/Agency j e lasers, beam in Budget Act	II, and reduce in boost phas l damage. The nder this programs that control, optic ivity 1, Basic	d e; is
) B. Program Change Summary (\$ in	Millions)						<b>EX 2007</b>		2000	<b>EX 2</b> 000
) Provious President's Pudget					<u>FY 20</u> 12.4		<u>FY 2007</u> 12.403		<u>2008</u> 2.524	FY 2009
<ul><li>) Previous President's Budget</li><li>) Current PBR/President's Budget</li></ul>					12.4		12.405		2.324 2.636	13.583 13.735
) Total Adjustments					-0.3		12.330	1	2.030	15.755
) Congressional Program Reductions					-0.5	72				
Congressional Rescissions							-0.047			
Congressional Increases							0.017			
Reprogrammings										
SBIR/STTR Transfer					-0.3	42				
) <u>Significant Program Changes:</u> Not Applicable.										
C. Performance Metrics			R-1	Line Item No. 3						
				Page-1 of 7					Exhibit R-2 (P	

Exhibit R-2	2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY <b>01 Basic Research</b>	PE NUMBER AND TITLE 0601108F High Energy Laser Resea	
Under Development.		
	R-1 Line Item No. 3	
	Page-2 of 7	Exhibit R-2 (PE 0601108F)

BUDGET ACTIVITY     PE NUMBER AND TILE 00011080F High Energy Laser     PROJECT NUMBER AND TILE 00011080F High Energy Laser     PROJECT NUMBER AND TILE 00011080F High Energy Laser       Cost (\$ in Millions)     Actual Estimate     Fstimate     Fstimate     Fstimate     Fstimate     Fstimate     Fstimate     Cost (\$ in Initiatves       5097     High Energy Laser Research Initiatves     12.072     12.356     12.636     13.733     14.079     14.299     14.581     14.883     Continuing     TBE       Quantity of RDTREE Articles     0			Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
Cost (s In Millions)         Actual         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Complete           5097         High Energy Laser Research         12.072         12.356         12.636         13.735         14.079         14.299         14.581         14.883         Continuing         TBE           Quantity of RDT&E Articles         0						06011	08F High Er	nergy Laser	50	97 High Ene		esearch
5097       High Energy Laser Research Initiatives       12.072       12.356       12.636       13.735       14.079       14.299       14.581       14.883       Continuing       TBE         Quantity of RDT&E Articles       0		Cost (\$ in Millions)										Total
<ul> <li>(U) A. Mission Description and Budget Item Justification         This program funds basic research aimed at developing fundamental scientific knowledge to support future Department of Defense (DoD) High Energy Laser (HEL)         systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced         logistics requirements. As a result, HELs have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase;         defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This         program are chosen for their potential to have a broad impact on multiple HEL systems and Service missions, while complementing Service/Agency programs that         are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics,         propagation, and free detectron lasers. The program funds theoretical, computational, and experimental investigations. This program key the detectron lasers. The program funds theoretical, computational, and experimental investigations. This program key heads are technologies are addressed in key areas such as chemical lasers, beam control, optics,         propagation, and free detectron lasers. The program funds theoretical, computational investigations. This program key heads are technologies.     </li> <li>(U) B. Accomplishments/Planned Program (S in Millions)         <ul> <li>(U) MAJOR THRUST: Improve the fundamental understanding of high-power laser sources, to include</li></ul></li></ul>	5097						14.079					TBD
This program funds basic research aimed at developing fundamental scientific knowledge to support future Department of Defense (DoD) High Energy Laser (HEL) systems. HEL systems have many potential advantages, including speed-of-light velocity, high precision, significant magazine depth, low-cost per kill, and reduced logistics requirements. As a rosult, HELs have the potential to perform a wide variety of military missions including interception of bullistic missiles in boost phase; defeat of high-speed, maneuvering anti-aircraft missiles; and ultra-precision negation of targets in urban environments with no collateral damage. This program are chosen for their potential to have a broad impact on multiple HEL systems and Service missions, while complementing Service/Agency programs that are directed at more specific Service needs. A broad range of technologies are addressed in key areas such as chemical lasers, solid state lasers, beam control, optics, propagation, and free electron lasers. The program funds theoretical, computational, and experimental investigations. This program is in Budget Activity 1, Basic Research, because it funds scientific study and experimentation. Through this program, the DoD invests in research directed toward increasing knowledge and understanding in those fields of science and engineering related to long-term national security needs.         (U) <b>B. Accomplishments/Planned Program (S in Millions) FY 2006 FY 2007 FY 2008 FY 2009</b> (U) <b>B. Accomplishments/Planned Program (S in Millions) FY 2006 FY 2007 FY 2008 FY 2009</b> (U) <b>B. Accomplishments/Planned Program (S in Millions) FY 2006 FY 2007 FY 2008 FY 2009</b>		Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
<ul> <li>(U) MAJOR THRUST: Improve the fundamental understanding of high-power laser sources, to include solid-state, free electron, and gas laser technologies.</li> <li>(U) In FY 2006: Initiated fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Initiated research to understand optically-pumped atomic and molecular gas lasers. Conducted free electron laser research on high-damage resonator optics, advanced optical cavity designs for high power, and scaling methodology for megawatt-class power levels. Conducted research in solid-state laser materials with large fluorescence lifetime and cross-section, and the ability to operate at high temperatures.</li> <li>(U) In FY 2007: Complete research on closed-cycle chemical, free electron, and solid state laser initiatives. Conduct fluor fluorand optically-pumped atomic and molecular gas lasers. Conduct fundamental research of optically-pumped atomic and molecular gas lasers. Conduct fluorand optically-pumped atomic and molecular gas lasers. Conduct fluorand optically-pumped atomic and molecular gas lasers. Conduct fluorand optically-pumped atomic and molecular gas lasers. Conduct fluorand optically-pumped atomic and molecular gas lasers. Conduct fluorand fluorand optically-pumped atomic and molecular gas lasers. Conduct fluorand fluorand optically-pumped atomic and molecular gas lasers. Conduct an ulti-disciplinary research institute (MRI) call for innovative research related to gas, free electron, and solid state laser topics.</li> <li>(U) In FY 2008: Conduct fiber laser research focused on single aperture scaling single-mode fibers, and R-1 Line Item No. 3</li> </ul>		systems. HEL systems have many po- logistics requirements. As a result, H defeat of high-speed, maneuvering an program is part of an overall DoD effo program are chosen for their potential are directed at more specific Service r propagation, and free electron lasers. Research, because it funds scientific s	tential advanta ELs have the p ti-ship and anti ort in HEL scie to have a broad needs. A broad The program f tudy and expen	ges, including ootential to per i-aircraft miss ence and techn id impact on n l range of tech funds theoretic rimentation.	speed-of-lig form a wide iles; and ultra ology conduc nultiple HEL nologies are a cal, computati Through this p	ht velocity, hig variety of mili- precision neg eted by the HE systems and S addressed in ke onal, and expe program, the D	gh precision, s tary missions i ation of target L Joint Techn ervice mission ey areas such erimental inve boD invests in	ignificant mag including inter is in urban env ology Office. ns, while comp as chemical la stigations. Th	gazine depth, i reception of ba vironments wi In general, er blementing Se sers, solid sta is program is	low-cost per k llistic missiles th no collatera fforts funded u ervice/Agency te lasers, beam in Budget Act	ill, and reduce in boost phas l damage. Th inder this programs that in control, optic ivity 1, Basic	d e; is cs,
<ul> <li>(U) In FY 2006: Initiated fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Initiated research to understand optically-pumped atomic and molecular gas lasers. Conducted research in chemical processes and chemical reactions for closed-cycle chemical lasers. Conducted free electron laser research on high-damage resonator optics, advanced optical cavity designs for high power, and scaling methodology for megawatt-class power levels. Conducted research in solid-state laser materials with large fluorescence lifetime and cross-section, and the ability to operate at high temperatures.</li> <li>(U) In FY 2007: Complete research on closed-cycle chemical, free electron, and solid state laser initiatives. Conduct fiber laser research focused on single aperture scaling single-mode fibers, and organization of multiple fibers. Conduct fundamental research of optically-pumped atomic and molecular gas lasers. Conduct a multi-disciplinary research institute (MRI) call for innovative research related to gas, free electron, and solid state laser topics.</li> <li>(U) In FY 2008: Conduct fiber laser research focused on single aperture scaling single-mode fibers, and R-1 Line Item No. 3</li> </ul>	(U)	MAJOR THRUST: Improve the fund	lamental under	rstanding of hi	igh-power las	er sources, to i	include					
R-1 Line Item No. 3	(U) (U)	In FY 2006: Initiated fiber laser rese organization of multiple fibers. Initia gas lasers. Conducted research in che lasers. Conducted free electron laser designs for high power, and scaling n in solid-state laser materials with larg at high temperatures. In FY 2007: Complete research on ch Conduct fiber laser research focused multiple fibers. Conduct fundamenta Conduct a multi-disciplinary research electron, and solid state laser topics.	arch focused of ted research to emical processo research on high hethodology for the fluorescence losed-cycle che on single apert l research of op institute (MR	n single apertu o understand o es and chemic gh-damage res r megawatt-cl lifetime and o emical, free el- ure scaling sir ptically-pump I) call for inno	ptically-pump al reactions for sonator optics ass power lever cross-section, ectron, and so agle-mode fib ed atomic and ovative researed	bed atomic and or closed-cycle , advanced oppress. Conducte and the ability olid state laser ers, and organ i molecular ga ch related to g	I molecular e chemical tical cavity ed research y to operate initiatives. ization of s lasers. as, free					
	(U)	In FY 2008: Conduct fiber laser rese	arch focused o	n single apertu	ure scaling sir	ngle-mode fibe	ers, and					
	Proie	ect 5097			<b>R</b> -1		3				Exhibit R-2a (P	E 0601108F)

Exh	DATE	DATE February 2007					
BUDGET ACTIVITY 01 Basic Research		PE NUMBER AND TITLE 0601108F High Ener Research Initiatives			CT NUMBER AND TITLE High Energy Laser Research ves		
(U) <b>B. Accomplishments/Planned Program</b> ( organization of multiple fibers. Conduct fu molecular gas lasers. Initiate research on a technologies.	undamental research of optically-pu	-	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2009: Conduct fiber laser research f organization of multiple fibers. Conduct fu molecular gas lasers. Conduct research on technologies.	undamental research of optically-pu	umped atomic and					
(U)							
<ul> <li>MAJOR THRUST: Improve the fundament to high power laser applications. Conduct component technology.</li> </ul>	-	• •	2.271	2.493	2.559	2.662	
<ul> <li>(U) In FY 2006: Improved negative thermal e substrates, and measured thermal and strain improved theoretical and computational attrain and thermal blooming effects. Discontinued</li> </ul>	n responses of these coatings. Cor mospheric propagation effects, adv	nducted research on					
(U) in FY 2007: Improve negative thermal exp substrates, and measured thermal and strain improved theoretical and computational atr and thermal blooming effects. Conduct an control technology and techniques.	n responses of these coatings. Cor mospheric propagation effects, adv	nplete research on anced wavefront sensing,					
(U) In FY 2008: Complete negative thermal ex improved beam control technologies and te	-	h on awarded topics for					
(U) In FY 2009: Conduct research on awarded techniques.	l topics for improved beam control	technologies and					
			1.520	1 7 4 5	1 704	1 700	
<ul> <li>(U) MAJOR THRUST: Evaluate high-fidelity</li> <li>(U) In FY 2006: Began to merge the developed validation techniques. Conducted mission-concepts.</li> </ul>	d models into a common architectu	re through verification and	1.520	1.765	1.794	1.700	
(U) In FY 2007: Merge the developed models validation techniques. Conduct mission-le							
Project 5097	F	R-1 Line Item No. 3 Page-4 of 7			Exhibit R-2a (I	PE 0601108E)	

	Exhibit R-2a, RDT&E Project J	DATE	DATE February 2007				
	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601108F High End Research Initiative	ergy Laser		NUMBER AND TITLE gh Energy Laser Research s		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Merge the developed models into a common architecture through v						
	validation techniques. Conduct mission-level HEL engagement scenarios and w	•					
(U)	In FY 2009: Merge the developed models into a common architecture, through validation techniques. Conduct mission-level HEL engagement scenarios and w						
(U)							
(U)	MAJOR THRUST: Fund educational grants intended to simulate interest in HE		0.556	0.648	0.705	0.810	
(U)	In FY 2006: Provided scholarships and internships to support to college student						
	degrees. Provided support to K-12 school programs to stimulate science and ma						
	emphasis on lasers and optics. Funded publication of journals and continuing ed						
	professionals in the HEL field. Initiated a Service Academy grant program to st	imulate HEL studies					
	among military cadets.						
(U)	In FY 2007: Provide scholarships and internships to support to college students						
	Provide grants to Service Academies to stimulate HEL studies among military c						
	to K-12 school programs to stimulate science and math studies, with an emphasis	-					
(II)	Fund publication of journals and continuing education for professionals in the H In FY 2008: Provide scholarships and internships to support to college students						
(0)	Provide grants to Service Academies to stimulate HEL studies among military c						
	to K-12 school programs to stimulate science and math studies, with an emphasi						
	Fund publication of journals and continuing education for professionals in the H	-					
aD	In FY 2009: Provide scholarships and internships to support to college students						
(0)	Provide grants to Service Academies to stimulate HEL studies among military c						
	to K-12 school programs to stimulate science and math studies, with an emphasi						
	Fund publication of journals and continuing education for professionals in the H	-					
(U)	F F						
(U)	CONGRESSIONAL ADD: Landscape Operational and Knowledge-based Chara	acterization.	0.671	0.000	0.000	0.000	
• •	In FY 2006: Conducted Congressionally-directed effort for Landscape Operation						
	Knowledge-based Characterization.						
(U)	In FY 2007: Not Applicable.						
(U)	In FY 2008: Not Applicable.						
	In FY 2009: Not Applicable.						
(U)	Total Cost		12.072	12.356	12.636	13.735	
	R-1	Line Item No. 3					
Pro		Page-5 of 7			Exhibit R-2a (F	PE 0601108E)	

	Exhibit	R-2a, RD	F&E Projec	t Justifica	tion			DATE	-ebruary 2007	
BUDGET ACTIVITY 01 Basic Research				0601	UMBER AND TI I <b>108F High E</b> earch Initiati	nergy Laser	Į.	PROJECT NUMBER AND TITLE 5097 High Energy Laser Research Initiatves		
(U) <u>C. Other Program Funding Su</u>	mmary (\$ in N	<u>(fillions)</u>								
	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> Complete	
<ul><li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li></ul>										
(U) PE 0602890F, High Energy Laser Research.										
<ul><li>(U) PE 0603444F, Maui Space Surveillance System.</li></ul>										
<ul> <li>PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.</li> </ul>										
(U) PE 0603605F, Advanced										
<ul><li>Weapons Technology.</li><li>(U) PE 0603924F, High Energy Laser Advanced Technology</li></ul>										
<ul><li>Program.</li><li>(U) PE 0603883C, Ballistic Missile Defense Boost Phase</li></ul>										
Segment. (U) PE 0602605F, Directed										
<ul><li>Energy Technology.</li><li>(U) PE 0602307A, Advanced Weapons Technology.</li></ul>										
(U) PE 0602114N, Power										
<ul> <li>Projection Applied Research.</li> <li>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate</li> </ul>										
Project 5097				R-1 Line Item No Page-6 of 7	o. 3				Exhibit R-2a (PE 0601108F)	
,				72						

Exhibit R-2a, RDT&E	Project Justification	DATE February 2007
IDGET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601108F High Energy Laser Research Initiatives	PROJECT NUMBER AND TITLE 5097 High Energy Laser Researc Initiatves
<b><u>C. Other Program Funding Summary (\$ in Millions)</u></b>		
duplication.		
<ul> <li><u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>		
Project 5097	R-1 Line Item No. 3 Page-7 of 7	Exhibit R-2a (PE 060110

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#### PE NUMBER: 0602015F PE TITLE: Medical Development

E	xhibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
BUDGET ACTIVITY D2 Applied Research					BER AND TITL	E Developme	nt			
Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cos		23.810	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
5244 Diabetes Research	0.000	23.810	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
<ul> <li>Iote: Funds for the FY 2007 Congression aillion, and Assessment and Demonstration or PE 0602015F, Medical Development</li> <li>U) A. Mission Description and Budget</li> </ul>	on Center for U , for execution.	SAF Surgeon		-			•			
Funds for the FY 2007 Congressiona million, and Assessment and Demon Program, from PE 0602015F, Medica	lly-directed Na stration Center	tional Diabetes for USAF Surg	geon General				•			
U) <u>B. Program Change Summary (\$ in</u>	<u>n Millions)</u>								••••	<b>TH 2</b> 000
D. Dec. in a Deccident's D. Jack					<u>FY 20</u>		<u>FY 2007</u>		2008	<u>FY 2009</u>
<ul><li>J) Previous President's Budget</li><li>J) Current PBR/President's Budget</li></ul>					18.4 0.0		0.000		0.000	0.000 0.000
<ul><li>J) Current PBR/President's Budget</li><li>J) Total Adjustments</li></ul>					-18.4		23.810		0.000	0.000
J) Congressional Program Reductions					-10.4	1.54				
Congressional Rescissions							-0.090			
Congressional Increases							23.900			
Reprogrammings					-18.4	34				
SBIR/STTR Transfer										
U) <u>Significant Program Changes:</u> Not Applicable.										
C. Performance Metrics Under Development.										
			R-1	Line Item No. 4 Page-1 of 3					Exhibit R-2 (Pl	<u>= 060</u> 2015F)
			UN	75 CLASSIFIE	D					

	Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on			DATE	February 2	2007
BUDGET ACTIVITY D2 Applied Research					IBER AND TITL	₋∈ I Developme		OJECT NUMBE		
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5244 Diabetes Research	0.000	23.810	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
<ul> <li>Note: Funds for the FY 2007 Congression nillion, and Assessment and Demonstration rom PE 0602015F, Medical Development</li> <li>U) <u>A. Mission Description and Budget</u> Funds for the FY 2007 Congressional million, and Assessment and Demons Program, from PE 0602015F, Medical</li> </ul>	on Center for Us , for execution. . Item Justifica Ily-directed Na stration Center	SAF Surgeon <u>tion</u> tional Diabete for USAF Sur	General in the s Model Prog geon General	e amount of \$1 ram in the amo	.4 million are ount of \$22.0	in the process million, Retina	of being mov	ved to the Defe	ense Health Pr amount of \$0	ogram,
<ul> <li>U) <u>B. Accomplishments/Planned Prog</u></li> <li>U) CONGRESSIONAL ADD: Nationa</li> <li>U) In FY 2006: Not Applicable.</li> <li>U) In FY 2007: Conduct Congressional</li> <li>U) In FY 2008: Not Applicable.</li> <li>U) In FY 2009: Not Applicable.</li> </ul>	r <mark>am (\$ in Mill</mark> l Diabetes Mod	<u>ions)</u> el Program.		odel Program.		<u>FY 20</u> 0.0		<u>7 2007</u> 21.917	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
<ul> <li>U)</li> <li>U) CONGRESSIONAL ADD: Assess</li> <li>U) In FY 2006: Not Applicable.</li> <li>U) In FY 2007: Conduct Congressional USAF Surgeon General.</li> <li>U) In FY 2008: Not Applicable.</li> <li>U) In FY 2009: Not Applicable.</li> </ul>				-		0.0	00	1.395	0.000	0.000
<ul> <li>U)</li> <li>U) CONGRESSIONAL ADD: Retinal</li> <li>U) In FY 2006: Not Applicable.</li> <li>U) In FY 2007: Conduct Congressional</li> <li>U) In FY 2008: Not Applicable.</li> </ul>			Eye Scan for	Pilots.		0.0	00	0.498	0.000	0.000
<ul><li>U) In FY 2009: Not Applicable.</li><li>U) Total Cost</li></ul>						0.0	00 2	23.810	0.000	0.000
			D 1	Line Item No. 4	1					

Exhibi	t R-2a, RDT&E	E Project Justifie	cation			DATE F	ebruary 2007
BUDGET ACTIVITY 02 Applied Research			E NUMBER AND TI 602015F Medic			OJECT NUMBER	R AND TITLE
(U) <u>C. Other Program Funding Summary (\$ in I</u>	<u>Millions)</u>						
<u>FY 2006</u> <u>Actual</u>		Y 2008FY 2009EstimateEstimate		FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete
(U) Related Activities: Not Applicable.							
(U) <u>D. Acquisition Strategy</u> Not Applicable.							
Project 5244		R-1 Line Item Page-3 o				E	Exhibit R-2a (PE 0602015F)
		77 UNCLASS	IFIED				

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#### PE NUMBER: 0602102F PE TITLE: Materials

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
	DGET ACTIVITY       PE NUMBER AND TITLE         Applied Research       0602102F Materials							-			
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	114.877	153.293	122.794	110.412	132.340	128.275	122.736	120.919	Continuing	TBD
01SP	Space Materials Development	0.000	26.511	34.496	32.254	38.750	39.456	38.660	39.217	Continuing	TBD
4347	Materials for Structures, Propulsion, and Subsystems	73.687	72.689	46.921	38.459	50.459	48.142	43.843	44.954	Continuing	TBD
4348	Materials for Electronics, Optics, and Survivability	18.880	28.710	21.780	20.116	21.834	19.217	18.315	14.267	Continuing	TBD
4349	Materials Technology for Sustainment	16.455	19.643	17.017	17.259	18.570	18.705	19.105	19.596	Continuing	TBD
4915	Deployed Air Base Technology	5.855	5.740	2.580	2.324	2.727	2.755	2.813	2.885	Continuing	TBD

Note: In FY 2007, Project 01SP, Space Materials Development, efforts transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5025, Space Materials Development, in order to more effectively manage and provide oversight of the efforts. Funds for the FY 2007 Congressionally-directed Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material Substitution and Repair in the amount of \$1.1 million are in the process of being moved to PE 0602102F, Materials, from PE 0702207F, Depot Maintenance, for execution.

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

This program develops advanced materials, processing, and inspection technologies to reduce life cycle costs and improve performance, affordability, supportability, reliability, and survivability of current and future Air Force systems and operations. The program has four projects that develop: (1) structural, propulsion, and sub-systems materials and processes technologies; (2) electronic, optical, and survivability materials and processes technologies; (3) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (4) air base operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Note: In FY 2007 Congress added \$1.0 million for Secure Coating Systems Technology, \$1.0 million for NanoMaterials Commercialization Center, \$1.0 million for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft, \$1.0 million for Integral Fuel Tank Protective Coating System, \$1.3 million for Accelerated Insertion of Advanced Materials for Materials Substitution and Repair - National Institute for Aviation Research, \$2.9 million for Wide Bandgap Materials Integration for Power Electronic, Sensor, and Optical Devices, \$1.4 million for Power Electronics Reliability, \$1.4 million for Fabrication and Processing of Adaptive Optics and Optical Materials, \$2.0 million for Electronic Type-specific Buckytubes for Next Generation Defense Electronics, \$2.0 million for Blast Resistant Panels for Buildings, Shelters, and Vehicles, \$1.0 million for High Temperature Aerogel materials for Global Strike Vehicles, \$1.0 million for Hybrid Materials Integration, \$1.0 million for Domestic Titanium Powder Manufacturing Initiative, \$1.0 million for Quantum Wire Program for Defense, \$1.4 million for Consortium for Nanomaterials for Aerospace commerce and Technology (CONTACT), \$2.3 million for ONAMI Safer Nanomaterials and Nanomanufacturing, \$2.0 million for domestic High Modulus PAN Carbon Fiber Qualification Initiative, \$3.3 million for Advanced Aerospace Manufacturing Technologies, \$1.0 million for Advanced Materials Deposition for Semiconductor Nanostructure, \$1.0 million for Advanced Materials Development for Force Protection, \$5.5 million for Air Force Minority Leader Program, \$1.3 million for Durable hybrid Coatings for Aircraft Systems, \$1.0 million for Engineered Optical Materials for Quantum Cryptography, \$1.1 million for Fire and Blast Resistant Materials for Force Protection, \$2.9 million for Advanced Coatings

Exhibit R-2 (PE 0602102F)

	Exhibit R-2, RDT8	E Budget Item Justification		DATE Februa	ry 2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials			-
	Technologies for JSF and F-22 Survivability, and \$1.0 millio program is in Budget Activity 2, Applied Research, since it o technologies.				ıry
(U)	<b>B. Program Change Summary (\$ in Millions)</b>				
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget	121.451	111.073	116.564	118.397
(U)	8	114.877	153.293	122.794	110.412
(U)	Total Adjustments	-6.574			
(U)	6 6				
	Congressional Rescissions	0.053	-0.580		
	Congressional Increases		38.900		
	Reprogrammings	-4.645	3.900		
(U)	SBIR/STTR Transfer Significant Program Changes:	-1.982			
	C. Performance Metrics Under Development.				
		R-1 Line Item No. 5 Page-2 of 30		Exhibit R-	2 (PE 0602102F)

				-	CLASSINIL						
		Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on			DATE	February 2	2007
	T ACTIVITY plied Research					IBER AND TITL			OJECT NUMBE	R AND TITLE	
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
01SP	Space Materials Development	0.000	26.511	34.496	32.254	38.750	39.456	38.660	39.217	Continuing	TB
T . 4	Quantity of RDT&E Articles	0	0	0	0		0	0	0		
	In FY 2007, Project 01SP, Space Ma ppment, in order to more effectively n		•			, Multidiscipi	inary Space 1	echnology, Pr	oject 5025, Sp	bace Materials	
T cu co R hi re	A. Mission Description and Budget I his project develops the materials and urrent and future Air Force space sys composites, and nonmetallic composit cocket propulsion materials developm igh-temperature protection materials esistant to meet space and ballistic mi systems and subsystems for space and	d processing to tems. Familie es to provide n ent in this pro are being devo issile requirem	echnology bas s of affordable new capabiliti ject supports eloped that are ents. Materia	e lightweight es for spaceers the Integrated affordable, li ils technologie	materials are b aft, ballistic m High Payoff F ightweight, dir	being develope issile, and pro Rocket Propuls nensionally st	ed, including n opulsion syster sion Technolo table, thermall	netals, polymons to meet the gy (IHPRPT) y conductive,	ers, ceramics, future space r program. Ad and/or ablatio	metallic requirements. vanced n and erosion	
<ul> <li>(U) M</li> <li>a</li> <li>(U) II</li> <li>(U) II</li> <li>c</li> <li>h</li> <li>p</li> <li>b</li> <li>a</li> <li>c</li> <li>c</li> <li>n</li> <li>a</li> <li>s</li> <li>(U) II</li> </ul>	<b>B. Accomplishments/Planned Progr</b> <i>M</i> AJOR THRUST: Develop material nd cost of rocket propulsion systems n FY 2006: Not Applicable. n FY 2007: Develop new candidate no onsistent material characteristics to no ousings and turbines, ducts, valves, see formance of subscale test component behavior in rocket combustion environ nd composite material candidates for omponents. Validate material model oupon level to more complex shapes naterials and concepts on demonstrate dvanced performance and cost goals. ub-components for thrust chambers, in n FY 2008: Optimize candidate mate- haracteristics to meet the next level of	s and processe materials and in neet the next lease the olid rocket case the olid rocket represent ment. Demo solid rocket represent and sizes. Far or engines. Id Improve and nozzles, and c erials and proc	es to dramatica improved proc evel of perform sings, insulati ntative rocket nstrate innova lozzles, exit co placement of n bricate subsca entify materia optimize sele atalysts. essing technic	cessing technic mance goals for on, and nozzle engine enviro tive high-tempones, throats, a naterials. Sca le component ls characterist octed materials	ques to ensure or high-speed e throats. Eval onment. Analy perature metal and spacecraft and spacecraft and spacecraft s. Incorporate tics required to s, test sub-elen more consiste	more turbopump luate vze material , ceramic, propulsion from innovative o meet nents, and ent material	<u>FY 20</u> 0.0		<u>7 2007</u> 11.500	<u>FY 2008</u> 3.634	<u>FY 2009</u> 3.591
tı	urbines, ducts, valves, solid rocket ca produce full scale test components that	sings, insulati	on, and nozzle	e throats. Dev gine environm	ent. Analyze	s to material					
_	tt 01SP				Line Item No. 5 Page-3 of 30	5				Exhibit R-2a (P	_

	Exhibit R-2a, RDT&E Pro	ject Justification		DATE	February	2007
	GET ACTIVITY pplied Research	PE NUMBER AND TITLI 0602102F Material			MBER AND TITLE Materials De	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> behavior in rocket combustion environment. Construct pervasive mater advanced performance and cost goals. Validate and demonstrate materi sub-components for thrust chambers, nozzles, and catalysts.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Down select the highest payoff materials and processes for housings and turbines, ducts, valves, solid rocket casings, insulation, and mechanical property databases for design consideration. Optimize proce components that can be tested in rocket engine environment. Analyze n combustion environment. Focus development plans on pervasive mater advanced performance and cost goals. Transition selected materials, tes sub-components for thrust chambers, nozzles, and catalysts.	d nozzle throats and develop esses to produce full scale test naterial behavior in rocket ials requirements to meet				
(U)						
	MAJOR THRUST: Develop affordable, advanced structural and non-st processing technologies for Air Force space applications.	ructural materials and	0.000	10.908	20.201	16.556
(U)	In FY 2006: Not Applicable. In FY 2007: Validate initial material design concept of candidate metal structures for component operation in robust high-temperature, long dur environments. Analyze research results and develop knowledge base or with National Aeronautics and Space Administration (NASA) and indus concepts using composite materials in cryogenic environments and prov assessment of structural cryogenic tanks. Demonstrate high-temperature expendable and reusable high-speed vehicle applications in collaboration oxidation protection schemes for carbon-carbon materials for high-speed enhancements obtained. Continue to develop wear-resistant materials, I Micro-Electro-Mechanical System (MEMS) devices for moving mechan Evaluate candidate space materials and collect critical data to facilitate r In FY 2008: Develop and validate test methodology and evaluation tech durability, and life prediction of thermal protection system applications materials. Develop scale-up processing and integration techniques that rabrication of complex geometries and built-up structures. Explore materials high-temperature protection systems for expendable and reusable high-speed structures and built-up structures.	ation cruise, or access to space liquid oxygen compatibility try. Evaluate large integrated ide expertise for design and e protection systems for n with industry. Validate d vehicle applications. Develop capabilities and evaluate ubricants, and hical assemblies on spacecraft. materials transition. miques for processing, for selected thin gage metallic will provide the capability for erials options for peed vehicle applications in				
Desi	collaboration with industry. Transition data on oxidation protection sch	R-1 Line Item No. 5 Page-4 of 30			Exhibit R-2a (I	

	Exhibit R-2a, RDT&E F	Project Justification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials			MBER AND TITLE Materials De	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> materials. Demonstrate benefits of nano-tailored composite materials applications. Validate wear-resistant materials, lubricants, and Micro (MEMS) devices for moving mechanical assemblies on spacecraft ag Evaluate candidate space materials and collect critical data to facilita	o-Electro-Mechanical System ainst environment specific criteria.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Transition initial test methodology and evaluation techn and life prediction of thermal protection system applications for comp high-temperature, long-duration cruise, or access to space environme development and demonstrate structural integration into sub-scale co environments. Develop materials candidates for high-temperature pr and reusable high-speed vehicle applications in collaboration with in- wear-resistant materials, lubricants, and Micro-Electro-Mechanical S mechanical assemblies on spacecraft against environment specific cri- materials and collect critical data to facilitate materials transition.	aiques for processing, durability, ponent operation in robust nts. Continue materials processing mponents for testing in relative rotection systems for expendable dustry. Continue to validate ystem (MEMS) devices for moving				
(U)						
(U)	MAJOR THRUST: Develop materials and materials processing tech performance and affordability of surveillance, tracking, targeting, situ space-based communications/computing.	•	0.000	4.103	10.661	12.107
(U)	In FY 2006: Not Applicable.					
(U)	In FY 2007: Initiate development of nano-photonic materials for hig devices for optical communications and system control architectures. process control methodology to enable very long wavelength infrared materials and materials process technologies for application in combi communication system apertures. Initiate research in nano-photonic high bandwidth communications and modulators, laser communication	Validate processes and develop d detection. Develop suitable and optical and radio frequency materials for applications in very				
(U)	In FY 2008: Demonstrate processes and process control methodolog infrared detection. Develop materials processing technology for shor provide capability of staring focal plane arrays with more than 4 mill nano-photonic materials for high performance optoelectronic devices system control architectures. Demonstrate materials and materials pr in combined optical and radio frequency communication system aper	rt wavelength detectors that will ion pixels (2k x 2k). Develop for optical communications and rocess technologies for application				
(U)	In FY 2009: Transition processes and process control methodology t					
	infrared focal plane arrays. Demonstrate processing technology for s					
		R-1 Line Item No. 5				

	Exhibit R-2a	a, RDTa	&E Projec	t Justificat	ion			DATE		
BUDGET ACTIVITY 02 Applied Research				PE NU	IMBER AND TIT			February 2007 CT NUMBER AND TITLE Space Materials Development		
(U) <u>B. Accomplishments/Planned Prog</u> en by hybridization and characterization materials for high performance optoel architectures. Transition suitable mat combined optical and radio frequency	of 2k x 2k forma lectronic devices terials and mater	at focal pl s for optications for optications for a second structure of the se	al communica ss technologie	tions and syste	m control	<u>FY 2006</u>	<u>FY 20</u>	<u>07 FY 2008</u>	<u>FY 2009</u>	
(U) Total Cost						0.000	26.5	11 34.496	32.254	
(U) <u>C. Other Program Funding Summa</u>	•									
E		<u>2007</u> timate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>			<u>Y 2013</u> Cost t Estimate Comple		
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>										
(U) <u><b>D. Acquisition Strategy</b></u> Not applicable.										
Project 01SP			F	R-1 Line Item No Page-6 of 30	. 5			Exhibit R-2a	(PE 0602102F)	
				84 NCLASSIFI	FD					

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY pplied Research					IBER AND TITL 02F Materia		43		R AND TITLE for Structu	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4347	Materials for Structures, Propulsion, and Subsystems	73.687	72.689	46.921	38.459	50.459	48.142	43.843	44.954	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	A. Mission Description and Budget This project develops the materials an future Air Force systems. A family of nonmetallic composites to provide up high-temperature turbine engine materials materials are being developed that are missile requirements. Alternative or r wear-resistant materials, paints, coatir spacecraft, and missiles. Concurrently	d processing to f affordable lig graded capabil rials that will of affordable, lig replacement m ngs, and other	echnology bas ghtweight mate ities for existi enable engine ghtweight, dim aterials are be pervasive non	erials is being ng aircraft, m designs to dou nensionally sta ing developed structural mat	developed, ind issile, and projuble the turbin able, thermally I to maintain therials technological	cluding metals pulsion system e engine thrus v conductive, a ne performanc ogies are being	s, polymers, co ns to meet the t to weight rat and/or ablation e of aging ope g developed for	eramics, metal future system io. Advanced and erosion re- rational syste- r propulsion a	llic composites requirements. high tempera resistant to me ms. Friction a	s, and Develops ture protectior et aerospace a nd	1
(U) (U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop ceramic performance and supportability impro- aerospace structures. In FY 2006: Designed, fabricated, an	es and ceramic ovements in ad ad tested advan	matrix compo- vanced propul	sion systems omposite cou	and high temp pons and sub-e	elements	<u>FY 20</u> 3.9		<u>7 2007</u> 3.833	<u>FY 2008</u> 3.191	<u>FY 2009</u> 2.398
	for demonstration of durability. Expa complex component shapes and apply material/component acceptance criter integrally cooled ceramic composites combustor. Scaled up advanced fiber ceramic composites.	to complex to ia. Validated by designing,	urbine compor advanced wea fabricating, ar	ent shapes. I ving and designd testing an a	Developed gn methodolog annular trapped	gy of 1 vortex					
(U)	In FY 2007: Demonstrate advanced of simulated engine service life condition ceramic composite life prediction more environmental exposure. Demonstrate composite systems with advanced into In FY 2008: Demonstrate advanced of simulated engine service life condition	ns. Incorporat del to address te the severe en erfaces via me ceramic compo	te environmen time depender nvironment du chanical testin osite performation	tal degradation at degradation rability of adv g. nce through te	n analysis into a associated wi vanced ceramic esting under re	o the th c al and					
	ect 4347			- R-1	Line Item No. 5 Page-7 of 30 85					Exhibit R-2a (P	E 0602102F)

	Exhibit R-2a, RDT&E Proje	ct Justification		DATI	February	2007
	<ul> <li>simulated engine service life conditions. Validate the life prediction model to ac degradation associated with environmental exposure. Validate the severe enviro advanced ceramic composite systems with advanced interfaces via mechanical to MAJOR THRUST/CONGRESSIONAL ADD: Develop enabling polymeric ma aerospace structural applications including enhanced aircraft canopies, micromed advanced wiring concepts, and improved low-observable platforms. Develop na address advanced Air Force conducting, structural, and electromechanical applic effort includes Congressional Add funding of \$16.2 million in FY 2006 (\$1.0 million service) as Future Materials for Defense and Energy Applications, \$1.7 Nanomaterials and Nanomanufacturing, \$1.5 million for Innovative Process for of Carbon Nanotube Membranes, \$11.0 million for Strategic Partnership for Ress Nanotechnology, \$1.0 million for Nano Organic Polymer Materials: Dynamic C million for Fully-Integrated Solar-Powered Interior Lighting) and \$5.7 million ir for ONAMI Safer Nanomaterials and Nanomanufacturing, \$1.4 million for Cons Nanomaterials for Aerospace Commerce and Technology (CONTACT), \$1.0 million for Fully-Integrated Solar-Powered Interior Lighting) and \$5.7 million for Cons Nanomaterials for Aerospace Commerce and Technology (CONTACT), \$1.0 million for Fully-Integrated Solar-Powered Interior Lighting) and \$5.7 million for Cons Nanomaterials for Aerospace Commerce and Technology (CONTACT), \$1.0 million for Fully-Integrated Solar-Powered Interior Lighting) and \$5.7 million for Cons Nanomaterials for Aerospace Commerce and Technology (CONTACT), \$1.0 million for Funderials Development for Force Protection, and \$1.0 million for Enabling Poly Three-Dimensional (3D) Microdevice Construction).</li> </ul>	PE NUMBER AND TITLE 0602102F Materials		PROJECT NUMBER AND TITLE 4347 Materials for Structures Propulsion, and Subsystems		
(U)	ceramic composite life prediction model. Validate the severe environment	-	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	simulated engine service life conditions. Validate the life prediction model degradation associated with environmental exposure. Validate the severe e	to address time dependent nvironment durability of				
(U) (U) (U)	aerospace structural applications including enhanced aircraft canopies, mic. advanced wiring concepts, and improved low-observable platforms. Devel address advanced Air Force conducting, structural, and electromechanical a effort includes Congressional Add funding of \$16.2 million in FY 2006 (\$1 Nanocomposites as Future Materials for Defense and Energy Applications, Nanomaterials and Nanomanufacturing, \$1.5 million for Innovative Process of Carbon Nanotube Membranes, \$11.0 million for Strategic Partnership for Nanotechnology, \$1.0 million for Nano Organic Polymer Materials: Dynan million for Fully-Integrated Solar-Powered Interior Lighting) and \$5.7 mill for ONAMI Safer Nanomaterials and Nanomanufacturing, \$1.4 million for Nanomaterials for Aerospace Commerce and Technology (CONTACT), \$1 Materials Development for Force Protection, and \$1.0 million for Enabling Three-Dimensional (3D) Microdevice Construction). In FY 2006: Developed second-generation two photon absorbing (TPA) m goggle and optical limiting applications. Investigated use of photonic cryst third-order nonlinear optical properties for use in optical limiting application life for Air Force aircraft tires by incorporation of nanostructured polymeric	romechanical devices, op nanoscale architectures to applications. Note: This .0 million for Polymer \$1.7 million for Safer s for Continuous Fabrication r Research in nic Camouflage, and \$1.0 ion in FY 2007 (\$2.3 million Consortium for .0 million for Advanced Polymeric Materials for aterials for night vision als to enhance second- and ons. Demonstrated improved c materials. Validated	20.360	11.312	6.364	5.869
	aromatic hyperbranched polymers as viscosity-lowering additives for struct via solvent-free processes. Investigated microfabrication of organic-inorga that have the potential to impact Air Force electromagnetic applications for conformal radar, and antenna systems. Developed adaptive (shape memory based on polymer nanocomposites for adaptive aircraft structures, wings, fi Scaled up improved polymer proton exchange membranes for high efficien	nic nanophotonic structures reduced aperture size, and actuator) materials ns, antennas, and mirrors. cy, long life, lightweight, fuel				
_	ject 4347	R-1 Line Item No. 5 Page-8 of 30			Exhibit R-2a (	

	Exhibit R-2a, RDT&E Pro	ject Justification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials		4347 Materi	IBER AND TITLE als for Structu and Subsyste	•
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> cell applications. Demonstrated polymer photovoltaic materials for high lightweight, solar cell applications.	efficiency, long life,	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Develop second-generation TPA materials for night vision applications. Demonstrate optical limiting with improvements in nonline photonic crystals. Demonstrate improved life nanostructured aircraft tire hyperbranched polymers as rheology-modifying additives for structural cresin transfer molding processes. Demonstrate organic-inorganic nanostre electromagnetic applications. Continue development of adaptive (shape based on polymer nanocomposites for adaptive aircraft structures, wings, Demonstrate polymer proton exchange membranes for Air Force fuel cell polymer photovoltaic materials for high efficiency, long life, lightweight	ear optical properties using es. Demonstrate aromatic component manufacture via ructured materials for Air Force memory and actuator) materials fins, antennas, and mirrors. l applications. Demonstrate				
(U)	In FY 2008: Deliver second-generation TPA materials for night vision g photonic crystals for super prism applications. Transition aromatic hyper structural component manufacture via resin transfer molding processes. metamaterials for Air Force electromagnetic and photonic applications for conformal radar, and antenna systems. Transition organic-inorganic name lightning strike resistant refueling boom. Develop electromagnetic interf microwave shielding for electronics hardening. Develop adaptive (shape materials based on polymer nanocomposites for adaptive aircraft structure mirrors. Develop lightweight, low-cost photovoltaics for uninhabited air	oggle evaluation. Transition rbranched polymers for Develop organic-inorganic or reduced aperture size, ostructured materials for Ference (EMI) and high power e memory and actuator) res, wings, fins, antennas, and				
	In FY 2009: Develop organic-inorganic metamaterials for Air Force elect applications for reduced aperture size, conformal radar, and antenna syste power microwave shielding for electronics hardening. Develop adaptive materials based on polymer nanocomposites for adaptive aircraft structur mirrors. Develop lightweight low-cost photovoltaics for uninhabited air	ctromagnetic and photonic ems. Develop EMI and high (shape memory and actuator) res, wings, fins, antennas, and				
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable light behavior and life prediction technologies, higher temperature intermetallit technology to enable enhanced performance, lower acquisition costs, incr reliability for Air Force weapon systems. Note: This effort includes Cor million in FY 2006 (\$1.0 million for Advanced Manufacturing Technology	ic alloys, and metals processing reased durability, and improved ngressional Add funding of \$4.4	18.524	21.428	15.737	11.476
		R-1 Line Item No. 5				

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007
BUDGET ACTIVIT 02 Applied Re		PE NUMBER AND TITLE 0602102F Materials		4347 Materi	ABER AND TITLE als for Structu and Subsyste	•
Materials, Computat Domestic	plishments/Planned Program (\$ in Millions) \$2.0 million for Domestic Titanium Powder Manufacturing Initiative, and ional Tools for Materials Development) and \$4.3 million in FY 2007 (\$1.0 Titanium Powder Manufacturing Initiative and \$3.3 million for Advanced uring Technologies).	) million for	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
materials- Explored emphasis and proce	6: Demonstrated reliable life extension capability for turbine engine rotor damage predictive approaches for engine health determination and life ext advanced metallic materials for enhanced performance propulsion for air p on higher temperature capability. Explored computational methods suppo ssing to reduce costs to accelerate insertion of advanced metals into Air Fo processes and protocols for unitized manufacturing of aerospace compone	ension capability. blatforms with an rting development bree systems.				
extension platforms supporting	7: Develop materials-damage predictive approaches for engine health det capability. Explore advanced metallic materials for enhanced performanc with an emphasis on higher temperature capability. Develop computation g development and processing to reduce costs to accelerate insertion of adv systems. Demonstrate processes and protocols for unitized manufacturing tts.	e propulsion for air al methods vanced metals into				
extension platforms	8: Develop materials-damage predictive approaches for engine health det capability. Develop advanced metallic materials for enhanced performance with an emphasis on higher temperature capability. Validate computation g development and processing to reduce costs to accelerate insertion of advasystems.	ce propulsion for air al methods				
(U) In FY 200 extension propulsion computati advanced	9: Validate materials-damage predictive approaches for engine health det capability. Develop and validate advanced metallic materials for enhance n for air platforms with an emphasis on higher temperature capability. Tra onal methods supporting development and processing to reduce costs to ad metals into Air Force systems.	d performance nsition				
structural for aerosp	THRUST/CONGRESSIONAL ADD: Develop affordable, advanced organ materials and technologies for Air Force systems applications including lin ace subcomponents and other structures requiring thermal and/or structures ental control. Note: This effort includes Congressional Add funding of \$3	ghtweight structures l management for	12.829	13.775	8.770	7.472
Project 4347	Page	Item No. 5 10 of 30 88			Exhibit R-2a (F	PE 0602102F)

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials		4347 Materi	ABER AND TITLE als for Structu and Subsyste	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> 2006 (\$1.0 million for Complex Composite Structures for Manned-Unmanned Air V million for Domestic High Modulus PAN Carbon Fiber Qualification Initiative) and 2007 (\$2.0 million for Domestic High Modulus PAN Carbon Fiber Qualification Initiation for High Temperature Aerogel Materials for Global Strike Vehicles, and \$1.0 million Materials Integration).	\$4.0 million in FY iative, \$1.0 million	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2006: Developed life prediction capabilities for high temperature turbine engi structures. Demonstrated high temperature organic matrix composites onto relevant Investigated and assessed future requirements for material development as applied to high-speed vehicle applications. Developed materials and processes for nanotailored multifunctional capabilities. Initiated nanomaterial modeling efforts. Demonstrated processes that enhance the reliability and performance of thermal management subsy	DoD platforms. next generation composites with novel materials and				
(U)	In FY 2007: Demonstrate tools and methodologies required for life prediction of mattemperature turbine engine and airframe structures environments. Demonstrate high organic matrix composites onto relevant DoD platforms. Initiate new material devel affordable processing for space and high-speed vehicle applications. Develop new n processes for nanotailored composites with multifunctional capabilities. Continue national modeling and technology efforts. Develop and demonstrate advanced material concert for thermal management applications.	terials in high temperature opment and aterials and nomaterial				
(U)	In FY 2008: Continue demonstration of life prediction tools for engine and airframe Transition high temperature organic matrix composites. Downselect and optimize m material systems for space and high speed vehicle applications. Demonstrate the mu of nanotailored composite materials for aerospace platform applications. Develop ar nanomaterials modeling and technology with an emphasis on accelerating the insertion this class of materials. Validate advanced composite material concepts and processes weapon system needs.	ost promising new ltifunctional payoffs d demonstrate on and transition of				
(U)	In FY 2009: Validate benefits of life prediction tools for engine and airframe application improved performance of new material systems for space and high-speed vehicle appet the developed models into commercial and industry tools. Transition advanced material processes to weapon and air vehicle platforms.	lications. Integrate				
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop nonstructural materials for f	luids, lubricants,	11.875	15.865	6.759	5.544
Pro	ject 4347 Page-	tem No. 5 1 of 30			Exhibit R-2a (F	PE 0602102F)

	Exhibit R-2a, RDT&E Project Jus	tification		DAT	E February	2007
	OGET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials		4347 Mater	MBER AND TITLE ials for Structor, and Subsyst	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> aircraft topcoat and corrosion resistant coatings, and specialty treatments to improve and reduce life cycle costs. Note: This effort includes Congressional Add funding of 2006 (\$1.0 million for Durable Hybrid Coatings for Aircraft Systems, \$1.0 million f Materials Coatings Research, and \$1.0 million Chrome-Free Environmentally Friend Protection for Aircraft) and \$7.2 million in FY 2007 (\$1.3 million for Durable Hybr Aircraft Systems, \$1.0 million for Chrome Free Environmentally Friendly Corrosion Aircraft, \$1.0 million for Secure Coating Systems Technology, \$1.0 million for Integ Protective Coating System, and \$2.9 million for Advanced Coating Technologies for Survivability).	of \$3.0 million in FY For Nanoparticle dly Corrosion rid Coatings for n Protection for gral Fuel Tank	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2006: Evaluated candidate materials for use in electrostatic discharge control Validated the advanced analytical models that will be used to predict the optical pro- coatings based on measured data. Demonstrated non-chromate surface treatments v Developed technologies for environmentally friendly corrosion protection systems v expectancy. Developed nanostructured multifunctional coatings to control friction a environments. Tested surface treatments for friction, stiction, and wear control in m	perties of specialty ia flight test. with a 30-year life and wear in extreme				
(U)		lete validation of the cialty coatings based or aircraft corrosion with a 30-year life elect surface				
(U)	-	nicles. Demonstrate coatings based on n protection systems. pectancy. omponents. Develop				
(U)	*	ions. Demonstrate Transition				
Pro		e Item No. 5 -12 of 30			Exhibit R-2a (	PE 0602102F)
		90				

	Exhibit R-2a, RDT&E Proje	DATE	DATE February 2007				
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials		4347 Materia	CT NUMBER AND TITLE Materials for Structures, Ision, and Subsystems		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Develop nanomaterials science and technology in the provide nano-reactive materials, additives, coated powders and laminates f with reduced size and higher lethality. Note: In FY 2008, this major thrus technologies from across the Air Force Research Laboratory to create an in effort.	or munitions and propulsion t pulls together existing	0.000	0.000	6.100	5.700	
(U)	In FY 2006: Not Applicable.						
(U)	In FY 2007: Not Applicable. In FY 2008: Investigate large-scale synthesis and characterization of energy						
(U)	stable, triggerable, nanoscale energetic materials for enhanced energy releat space. Discover and design unconventional nanomaterial behavior with re- robust modeling and simulation. Investigate the transport and compartmer within the environment. Develop microstructural characterization tools to processing-performance correlations of nanoenergetic systems. Investigate nanoparticle catalyses as controlled release agents for enhancing stability a providing enhanced ignition for high efficiency air-breathing propulsion. In FY 2009: Develop large-scale synthesis and characterization of energet stable, triggerable, nanoscale energetic materials for enhanced energy releat air-breathing propulsion, and access to space. Establish modeling and sim nanoenergetics development. Analyze the transport and compartmentalizat investigated as nanoenergetics to evaluate potential environmental impact. characterization tools to provide robust processing-performance correlation Investigate multi-component, structured nanoparticle catalyses as controlled enhancing stability and storage as well as providing enhanced ignition.	gard to energy release via talization of nanoparticles provide robust e multi-component, structured nd storage as well as ic nanomaterials to provide use munitions, high efficiency ulation tools to support tion of nanoparticles being Develop microstructural ns of nanoenergetic systems.					
(U)			1.7.4.4	0.000	0.000	0.000	
(U)	CONGRESSIONAL ADD: Minority LEADERS Research Program.	DEDC Desserve Drammer	1.744	0.000	0.000	0.000	
(U) (U)	In FY 2006: Conducted Congressionally-directed effort for Minority LEA In FY 2007: Not Applicable.	DEKS Kesearch Program.					
	In FY 2007: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U)	······						
		R-1 Line Item No. 5					

		Exhibit	R-2a, RD	C&E Projec	ct Justificat	ion			DATE	February	2007
BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602102F Materials			347 Material	iBER AND TITLE als for Structures, and Subsystems			
(U)	<b>B. Accomplishments/Planned</b>	Program (\$ in	<u>Millions)</u>				<u>FY 20</u>	<u>06</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U)	CONGRESSIONAL ADD: Air	Force Minority	/ Leader Progra	am.			3.3	92	5.480	0.000	0.000
(U)	In FY 2006: Conducted Congre	-				-					
(U)	In FY 2007: Conduct Congress	ionally-directed	l effort for Air	Force Minorit	y Leader Progra	ım.					
(U)	In FY 2008: Not Applicable.										
(U)	In FY 2009: Not Applicable.										
(U)				_							
(U)	CONGRESSIONAL ADD: Nat				~		0.9	69	0.996	0.000	0.000
(U)	In FY 2006: Conducted Congre	ssionally-direc	ted effort for N	anomaterials (	Commercializat	ion Center of					
(II)	Pennsylvania.	onally director	offort for Nor	Matariala Ca	mmanaializatio	n Conton					
(U) (U)	In FY 2007: Conduct Congress In FY 2008: Not Applicable.	ionally-directed	l enort for Man	iomateriais Co	ommercianzatio	li Center.					
(U)	In FY 2009: Not Applicable.										
(U)	Total Cost						73.6	87	72.689	46.921	38.459
(0)							75.0	07	12.009	10.921	50.157
(U)	C. Other Program Funding Su	•									
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	TOTAL COSE
(T. 1)		<u>Actual</u>	<u>Estimate</u>	Estimate	Estimate	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	2
` '	Related Activities:										
(U)	PE 0602500F,										
	Multi-Disciplinary Space										
ЛD	Technology. PE 0603112F, Advanced										
(0)	Materials for Weapon										
	Systems.										
ധ	PE 0603211F, Aerospace										
(-)	Technology Dev/Demo.										
(U)	PE 0603216F, Aerospace										
	Propulsion and Power										
	Technology.										
(U)	This project has been										
	coordinated through the										
	Reliance 21 process to										
Pro	oject 4347				R-1 Line Item No Page-14 of 30					Exhibit R-2a (I	PE 0602102F)
					92						_ 00021021 )

Exhibit R-2a, RDT&E Pr	February 2007		
UDGET ACTIVITY 2 Applied Research			NUMBER AND TITLE terials for Structures, ion, and Subsystems
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>			
harmonize efforts and			
eliminate duplication.			
U) <b>D. Acquisition Strategy</b> Not Applicable.			
Project 4347	R-1 Line Item No. 5 Page-15 of 30		Exhibit R-2a (PE 0602102

		Exhibit R-	2a, RDT&E	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY oplied Research					IBER AND TITL 02F Material		43	OJECT NUMBE 48 Materials otics, and Su	for Electro	nics,
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4348	Materials for Electronics, Optics, and Survivability	18.880	28.710	21.780	20.116	21.834	19.217	18.315	14.267	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
1 a t	A. Mission Description and Budget This project develops materials technomicrowave, and infrared detection and ircrews, sensors, and aircraft from last o enable surveillance and situational a higher operating temperatures), greate o respond to emerging and agile threa	ologies for sur- l countermease ser and high-p awareness with r sensitivity, a	veillance and s ures devices us ower microwa n faster operat nd extended d	sed for targeti ve directed er ing speeds, gr ynamic range	ng, electronic hergy threats a eater tunabilit . New materia	warfare, and a re also develo y, higher powe	ctive aircraft ped. Electron er output, imp	protection. M ic and optical roved thermal	laterials for pr materials are management	otection of being develop (including	ed
(U)	<b>B. Accomplishments/Planned Progr</b>	am (\$ in Mill	ions)				<u>FY 20</u>	06 F	<u> 2007</u>	<u>FY 2008</u>	FY 2009
(U)	MAJOR THRUST: Develop, evaluat processing technologies to enable imp Force surveillance, tracking, targeting In FY 2006: Provided prototype grow systems to determine unique properties enable ordered growth of two-dimens materials. Validated the optical prope evaluation of complex IR detector ma methods of controlling materials comp structural characterization.	proved perform , and situation wth, characterizes of interest to ional, abrupt c erties of advan terials that hav position, shape	hance, affordal al awareness s zation, and ana o Air Force use ompositional ced IR materia ve been produce e, and size on a	pility, and oper systems. alyses of poten ers. Develope interfaces in n als by optical ced by atomic a nano-scale le	erational capab ntial IR materi ed the process nultiple wavel characterizatio level control. evel and valid	bility of Air als control to ength on and Explored ate by	0.6	51	1.317	1.731	1.533
(U)	In FY 2007: Validate optical, structure determine their ability to provide unique Characterize and evaluate the utility of than two discrete wavelengths. Invest unique detection properties of comple- for nano-scale IR detection materials. In FY 2008: Explore and validate sui to assess appropriateness for Air Force systems capable of responses to more	ue IR detection of single element tigate the potent ox IR materials table materials e IR detection	on properties o nt multispectr ntial for three- . Validate pro s and structure applications.	f interest to the al IR material dimensional r omising mater s for innovati Design and d	he Air Force. Is with response material growt ials growth teo ve IR material emonstrate IR	ses to more h to exploit chnologies s in order materials					
Proje	ct 4348				Line Item No. 5 Page-16 of 30 94	5				Exhibit R-2a (P	E 0602102F)

	Exhibit R-2a, RDT&E Project Justification					
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602102F Materials			February 2007 NUMBER AND TITLE terials for Electronics, and Survivability	
research and util complex IR mate materials. Devel materials to enab substrates to enab power dense dev	nents/Planned Program (\$ in Millions) ity of three-dimensional material growth to exploit under erials. Develop promising materials growth technologi lop epitaxial materials and devices fabricated for high p ole development of design capabilities. Improve materials ble higher power efficiency, better reliability, and incre- ices. velop materials and transition strategies for innovative	es for nano-scale IR detection power applications. Investigate ials matching between device and eased power density to enable	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
exploit newly en responses to mor growth to exploi growth technolog substrate improv	herging material concepts. Validate and optimize IR movements that the state of the	aterials systems capable of naterials for three-dimensional Develop promising materials re epitaxial materials device and aterials and substrates. Develop				
	ST: Develop and demonstrate enabling materials techn mission effectiveness of Air Force sensors and viewin		1.726	0.000	0.000	0.000
(U) In FY 2006: De device concepts	yor thrust merge into the survivability thrust below. veloped photorefractive materials for passive protection that utilize photorefractive materials. Optimized the per- wavelength switchable filter technology for Air Force	erformance of high optical				
(U) In FY 2007: No	t Applicable.					
<ul><li>(U) In FY 2008: No</li><li>(U) In FY 2009: No</li></ul>						
(U) III 1 2009. NO	t Applicable.					
(U) MAJOR THRUS survivability, and	ST: Develop and demonstrate enabling materials techn d mission effectiveness of aircrews, sensors, viewing synthesis from the previous survivability thrust merge into th	ystems, and related assets. Note:	4.765	8.470	9.782	8.677
concepts for eye	aracterized the performance of optimized nonlinear abs and sensor system protection.	-				
	orporate optimized nonlinear optical limiter materials f Optimize photorefractive materials properties for Air F					
Project 4348		R-1 Line Item No. 5 Page-17 of 30			Exhibit R-2a (F	

Exhibit R-2a, RDT&E Project Justification						2007	
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602102F Materials	PE NUMBER AND TITLE 0602102F Materials			MBER AND TITLE rials for Electronics, d Survivability	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> applications. Incorporate switchable filter technology into device concept protection.	s for eye and sensor system	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Demonstrate optimized nonlinear optical limiter materials for and sensor systems. Validate photorefractive materials properties for Air applications. Develop devices using switchable filter technology into eye concepts.	Force passive protection					
(U)	In FY 2009: Develop nonlinear optical limiter materials into device conce eyes and sensor systems. Develop photorefractive materials into device con- protection applications. Demonstrate devices using switchable filter technic system protection concepts.	oncepts for Air Force passive					
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate technologies for power generation, power control, and microwave compon performance, affordability, and operational capability for Air Force survei situational awareness, and lethal and non-lethal weapon systems. Note: T Congressional Add funding of \$6.3 million in FY 2006 (\$3.2 million for F \$2.1 million for Large Area, APVT Materials for Hi-Powered Devices, an Materials Deposition for Semiconductor) and \$2.4 million in FY 2007 (\$1 Electronics Reliability and \$1.0 million for Advanced Materials Deposition	nents to provide improved llance, tracking, targeting, This effort includes Power Electronics Reliability, d \$1.0 million for Advanced .4 million for Power	10.672	10.654	8.283	7.988	
(U)	In FY 2006: Demonstrated scale-up of materials and materials processes a advanced radar, and electronic countermeasures. Developed advanced matechnologies to enable airborne lethal and non-lethal directed energy weap and an order of magnitude improvement in speed for Air Force sensor and Demonstrated scale-up of materials and materials processes to provide pre- performance for power control systems, advanced radar, and electronic co- advanced materials and materials process to provide improve capabilities relative to baseline materials/processes for ultra-lightweight, u electrical generators enabling airborne lethal and non-lethal directed energy aircraft. Developed materials and materials process technologies for Tera order of magnitude improvement in speed for Air Force sensor and comm most promising materials approaches for application to initial prototype ev	terials and materials process oons in fighter-sized aircraft, communication systems. esently unattainable untermeasures. Developed ements and additional ultra-high-power aircraft sy weapons in fighter-sized hertz components supporting unication systems. Identified					
Pro	ject 4348	R-1 Line Item No. 5 Page-18 of 30			Evhibit P. 2a (I	PE 0602102F)	

	Exhibit R-2a, RDT&E Proj	ect Justification		DATE	February	2007				
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602102F Materials								onics,
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2007: Demonstrate capabilities of advanced materials and material enable airborne lethal and non-lethal directed energy weapons in fighter-s scale-up of materials and materials processes to provide presently unattain control systems, advanced radar, and electronic countermeasures. Demon materials and materials process technologies to provide improvements and relative to baseline materials/processes for ultra-lightweight, ultra-high-po generators enabling airborne lethal and non-lethal directed energy weapor Validate and demonstrate selected materials and materials process technologies to components, supporting high speed communications and advanced sensor	ized aircraft. Demonstrate nable performance for power astrate capabilities of advanced d additional capabilities ower aircraft electrical ns in fighter-sized aircraft. logies for use in Terahertz	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>				
(U) (U)	In FY 2008: Explore materials impact on device reliability for power con and electronic countermeasures application. Demonstrate the capabilities technologies as well as investigate the reliability of materials as applied to ultra-high-power aircraft electrical generators enabling airborne lethal and weapons in fighter-sized aircraft. Demonstrate performance of candidate components, supporting high speed communications and advanced sensor In FY 2009: Optimize materials properties for enhanced device reliability materials for ultra-lightweight, ultra-high-power aircraft electrical generat airborne lethal and non-lethal directed energy weapons in fighter-sized air performance of candidate materials for use in Terahertz components, supp communications and advanced sensors.	trol systems, advanced radar, of advanced materials process o ultra-lightweight, d non-lethal directed energy materials for use in Terahertz rs. y. Assess the reliability of tor applications, enabling rcraft. Demonstrate								
	MAJOR THRUST: Develop enabling and foundational biotechnologies f control, rapid tagging, tracking, and identification of targets, and bio-inte for continued Air Force dominance. Note: In FY 2008, this major thrust technologies from across the Air Force Research Laboratory to create an i effort for taggants.	grated electronics and sensing pulls together existing	0.000	0.000	1.984	1.918				
(U)	In FY 2006: Not Applicable. In FY 2007: Not Applicable. In FY 2008: Investigate use of biological/nanomaterial-based taggants fo identification of CBRNE targets at a distance using hybrid constructs. As destruction using taggants in counterproliferation operations. Neutralize b	sess effectiveness of CBRNE biological and chemical agents								
Pro	ject 4348	R-1 Line Item No. 5 Page-19 of 30			Exhibit R-2a (F	PF 0602102F)				

	Exhibit R-2a, RDT&E Proje	DATE		2007		
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602102F Materials		4348 Materi	February 2007 JMBER AND TITLE rials for Electronics, d Survivability	
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> with the inherent and supplementary properties of the taggant nanoparticles. polymer encapsulation technologies for taggant materials.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(0)	In FY 2009: Develop new biological/nanomaterial hybrids for the detection CBRNE agents. Analyze efficacy data of using taggants to destroy CBRNE taggants into a variety of media (polymers, paints) for optimal and mission-dispersion properties of polymer-encapsulated taggants for optimal release a	E agents. Incorporate specific dispersal. Model				
(U) (U)	CONGRESSIONAL ADD: Engineered Optical Materials for High Energy	Laser Development.	1.066	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Engineered Opt Energy Laser Development.	-				
	In FY 2007: Not Applicable.					
. /	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U) (U)	CONGRESSIONAL ADD: Engineered Optical Materials for Quantum Cry	ntography	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.	prography.	0.000	0.770	0.000	0.000
` ´	In FY 2007: Conduct Congressionally-directed effort for Engineered Optic. Cryptography.	al Materials for Quantum				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)	CONCREGIONAL ADD. EL. (		0.000	1.002	0.000	0.000
(U)	CONGRESSIONAL ADD: Electronic Type-specific Buckytubes for Next Electronics.	Generation Detense	0.000	1.993	0.000	0.000
(U)	In FY 2006: Not Applicable.					
(U)	In FY 2007: Conduct Congressionally-directed effort for Electronic Type-s Generation Defense Electronics.	pecific Buckytubes for Next				
	In FY 2008: Not Applicable.					
` ´	In FY 2009: Not Applicable.					
(U)			0.000	1 205	0.000	0.000
(U) (U)	CONGRESSIONAL ADD: Fabrication and Processing of Adaptive Optics In FY 2006: Not Applicable.	and Optical Materials.	0.000	1.395	0.000	0.000
Pro	ject 4348	R-1 Line Item No. 5 Page-20 of 30			Exhibit R-2a (	PE 0602102F)

Exhibit R-2a, RDT&E F	ect Justification		DATE	February	2007	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials		PROJECT NUMBER AND TITLE 4348 Materials for Electronics, Optics, and Survivability			
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2007: Conduct Congressionally-directed effort for Fabrication	Processing of Adaptive Optics					
and Optical Materials.						
(U) In FY 2008: Not Applicable.						
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>						
(U) CONGRESSIONAL ADD: Quantum Wire Program for Defense.		0.000	0.996	0.000	0.000	
(U) In FY 2006: Not Applicable.		0.000	0.990	0.000	0.000	
(U) In FY 2007: Conduct Congressionally-directed effort for Quantum V	Program for Defense.					
(U) In FY 2008: Not Applicable.	C					
(U) In FY 2009: Not Applicable.						
(U)						
(U) CONGRESSIONAL ADD: Wide Bandgap Materials Integration for	er Electronic, Sensor, and	0.000	2.889	0.000	0.000	
Optical Devices.						
<ul><li>(U) In FY 2006: Not Applicable.</li><li>(U) In FY 2007: Conduct Congressionally-directed effort for Wide Band</li></ul>	Materials Integration for					
Power Electronic, Sensor, and Optical Devices.	Waterials integration for					
(U) In FY 2008: Not Applicable.						
(U) In FY 2009: Not Applicable.						
(U) Total Cost		18.880	28.710	21.780	20.116	
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>						
<u>FY 2006</u> <u>FY 2007</u> <u>FY 2</u>	<u>FY 2009</u> <u>FY 2010</u>	<u>FY 2011</u> <u>FY 2012</u>	<u>2 FY 2013</u>	Cost to	Total Cost	
Actual Estimate Est	<u>e Estimate Estimate</u>	Estimate Estima	te <u>Estimate</u>	<u>Complete</u>	<u>10181 COSI</u>	
(U) Related Activities:						
(U) PE 0602500F,						
Multi-Disciplinary Space						
Technology. (U) PE 0603112F, Advanced						
Materials for Weapon						
Systems.						
(U) PE 0602202F, Human						
Effectiveness Applied						
Project 4348	R-1 Line Item No. 5 Page-21 of 30			Exhibit R-2a (F	E 0602102E	
F10jeu 4340	Page-21 of 30 99			Exhibit K-2a (F	= 0002102F)	

Exhibit R-2a, RDT&E	DATE	February 2007	
BUDGET ACTIVITY 02 Applied Research			
<ul> <li>(U) C. Other Program Funding Summary (\$ in Millions) Research.</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0603211F, Aerospace Technology Dev/Demo.</li> <li>(U) PE 0603231F, Crew Systems and Personnel Protection Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>			
Project 4348	R-1 Line Item No. 5 Page-22 of 30 100		Exhibit R-2a (PE 0602102F

	Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007	
BUDGET ACTIVITY 02 Applied Research					MBER AND TITL 02F Materia		43	PROJECT NUMBER AND TITLE 4349 Materials Technology for Sustainment			
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
4349 Materials Technology for Sustainment	16.455	19.643	17.017	17.259	18.570	18.705	19.105	19.596	Continuing	TBD	
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0			
Note: Funds for the FY 2007 Congression Repair in the amount of \$1.1 million are in										on and	
This project develops materials and delivered systems, transitioning mor characterizing materials processes an commands and repair centers. Repainon-metallic structures, coatings, coa- essential to ensure optimum quality detect the onset of any service-initial (1) B. A second is human to for any service initial	e reliable and m ad properties ne r techniques an rosion control j n the design an ed damage and	aintainable m cessary for ma d nondestruction processes, and d production of /or deterioration	aterials, estab aterials transit we inspection to support into of aircraft, pro	lishing a capal ion, and provi- /evaluation (N tegration of co pulsion, and n	bility to detect ding quick rea IDI/E) method omposite struct nissile systems	and character ction support s are develope sures for aeros s. These NDI/	ize performar and failure an ed that are nee pace systems. 'E methods are	nce threatening alysis to the o ded for metall Various NDI e also essentia	g defects, perational ic and /E methods ar l to monitor at	e nd	
<ul> <li>(U) <u>B. Accomplishments/Planned Prog</u></li> <li>(U) MAJOR THRUST: Develop NDI/E aerospace structures, propulsion sys</li> <li>(U) In FY 2006: Demonstrated electron cracks in large area, aging structures response to enable rapid assessment Initiated efforts to explore and devel aircraft structures with complex geo systems for use in battle damage ass Transitioned sensor technology for a dielectric tiles.</li> <li>(U) In FY 2007: Continue to develop complex for the sensor technology for the sensor tec</li></ul>	technologies to tems, and comp nagnetic techno . Developed co of multiple ND op NDI/E techn metries. Evalua essment and for neasuring comp	b identify and lex, low-obser logy to detect omputer simul I/E technolog nologies for in ated feasibility inspection fo olex electroma	vable (LO) m and character ations and mo ies for depot 1 spection of th of advanced llowing battle gnetic materia	naterials and st ize multi-site c odels of NDI/E evel inspection ick (multi-laye LO NDI/E me e damage repai al properties be	ructures. damage and technique ns. er) aging ethods and ir. eneath	<u>FY 20</u> 3.6		<u>Y 2007</u> 5.784	<u>FY 2008</u> 6.343	<u>FY 2009</u> 6.376	
enable rapid assessment of multiple technologies for inspection of thick Develop advanced LO NDI/E metho inspection following battle damage	NDI/E technolo (multi-layer) ag ods and systems repair.	ogies for depor ing aircraft stu for use in bat	t level inspect ructures with o tle damage as	ions. Develop complex geom sessment and t	NDI/E netries. for						
<ul><li>(U) In FY 2008: Mature modeling and s</li><li>Project 4349</li></ul>	imulation meth	odologies for	- R-1	ent of multiple 1 Line Item No. 5 Page-23 of 30 101					Exhibit R-2a (P	E 0602102F)	

	Exhibit R-2a, RDT&E Proj	ect Justification		DATI	DATE February 2007			
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials			CT NUMBER AND TITLE Materials Technology for inment			
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> technologies for depot level inspections. Validate NDI/E technologies for (multi-layer) aging aircraft structures with complex geometries. Initiate s sensors to enable health management for turbine engines and thermal prof In FY 2009: Demonstrate novel NDI/E methods and techniques to detect	studies of harsh environment tection systems. and track damage in a wide	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	variety of materials and components for aerospace systems. Demonstrate inspection of thick (multi-layer) aging aircraft structures with complex ge technology to detect changes in temperature, strain, pressure, and vibration status of turbine engines, aircraft structures, wiring systems, and thermal p	cometries. Develop sensing on to enable on-demand health						
(U) (U)	MAJOR THRUST: Develop support capabilities, information, and proce	esses to resolve problems with	4.955	7.081	4.889	4.998		
(0)	materials in the repair of aircraft structures and to reduce aircraft corrosio	-	4.955	7.001	4.009	4.770		
(U) (U)	In FY 2006: Applied methodologies to evaluate corrosion and erosion re- materials used in operationally fielded Air Force systems. Evaluated met for MEMS structures and subsystems. Evaluated effects of defects in lase In FY 2007: Continue to evaluate corrosion and erosion resistance of new in operationally fielded Air Force systems. Continue to evaluate methodo MEMS structures and subsystems. Validate effects of defects in laser add	hodologies to test failure limits er additive manufactured parts. w and emerging materials used plogies to test failure limits for						
(U)	In FY 2008: Develop advanced techniques to evaluate corrosion and erose emerging materials used in operationally fielded Air Force systems. Develop processes technology to repair Air Force legacy systems and test failure lis systems. Initiate analysis to understand the effects of materials processes residual stress on the surface of steel and other structural metals, to suppor and point design solutions that will extend the life of specific components Demonstrate technologies for improved maintainability of advanced LO r conductive outer-mold-line, applique, door edges and seals, and multifund	sion resistance of new and elop advanced materials and imits for emerging Air Force , such as the application of ort customer focused studies s on Air Force systems. materials and designs, such as ctional systems.						
(U)	In FY 2009: Validate advanced techniques to evaluate corrosion and eros emerging materials used in operationally fielded Air Force systems. Eval processes technology to repair Air Force legacy systems and test failure li systems. Develop test methods and techniques to understand the effects of application of residual stress on the surface of steel and other structural n point design solutions that will extend the life of specific structural compo	luate advanced materials and imits for emerging Air Force of materials processes, like the netals, to support studies and onents on Air Force systems.						
_	ject 4349	R-1 Line Item No. 5 Page-24 of 30			Exhibit R-2a (F			

	Exhibit R-2a, RDT&E Project J	lustification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials		PROJECT NUM 4349 Materi Sustainmer		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> Demonstrate and transition technologies for improved maintainability of advance designs, such as conductive outer-mold-line, applique, door edges and seals, and systems.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)						
	MAJOR THRUST: Develop support capabilities, information, and processes to problems and provide electronic and structural failure analysis of components.	3.950	4.694	5.785	5.885	
(U)	In FY 2006: Performed failure analysis and materials investigations for field, ac organizations. Demonstrated electrostatic discharge protection technologies and emerging avionics subsystems. Evaluated new test methodologies for analyzing emerging materials for Air Force systems. Evaluated wiring materials technologies wiring systems and new wiring technologies for emerging weapons systems.	l procedures for structural failures of				
(U)	In FY 2007: Continue performing failure analysis and materials investigations for depot organizations. Continue demonstration of electrostatic discharge protection procedures for emerging avionics subsystems. Validate new test methodologies failures of emerging materials for Air Force systems. Evaluate/validate wiring replace aging wiring systems and new wiring technologies for emerging weapor	on technologies and for analyzing structural naterials technologies to				
(U)	In FY 2008: Perform quick response failure analysis and materials investigation acquisition organization, depot system materials failures, and provide advanced ensure system availability and safety of flight. Develop advanced electrostatic of technologies and procedures for emerging avionics subsystems. Demonstrate ac methodologies for analyzing structural failures of emerging materials for Air Fo advanced wiring materials technologies to replace aging wiring systems and new emerging weapons systems.	ns for fielded system, materials solutions to lischarge protection lvanced test rce systems. Develop				
U)	In FY 2009: Perform quick response failure analysis and materials investigation acquisition organization, depot system materials failures, and provide advanced ensure system availability and safety of flight. Develop advanced electrostatic of technologies and procedures for emerging avionics subsystems. Demonstrate ac methodologies for analyzing structural failures of emerging materials for Air Fo advanced wiring materials technologies to replace aging wiring systems and new emerging weapons systems.	materials solutions to lischarge protection lvanced test rce systems. Develop				
(U)						
		Line Item No. 5 lage-25 of 30			Exhibit R-2a (F	PE 0602102F)

		Exhibit	t R-2a, RD	T&E Projec	t Justifica	tion			DATE	Fabruary	2007
	GET ACTIVITY pplied Research		-		PE N	UMBER AND TI 2102F Materi	February 2007 PROJECT NUMBER AND TITLE 4349 Materials Technology for Sustainment				
(U)	<b>B. Accomplishments/Planned</b> MAJOR THRUST: Develop e Note: In FY 2008, efforts in th	nabling technolo	ogies to reduce combined with	n other major tl	hrusts in this pr	oject.	<u>FY 20</u> 3.9	<u>)06 ]</u> 908	<u>FY 2007</u> 0.789	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
	In FY 2006: Developed multis Investigated program for impro- conductive outer-mold-line, ap NDI/E.	oved maintainabi plique, door edg	ility of advance es and seals, m	ed LO material nultifunctional	s and designs i systems, and e	ncluding mbedded LO					
(U)	In FY 2007: Develop technolo such as conductive outer-mold- embedded LO NDI/E.			-		-					
(U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.										
(U) (U)	CONGRESSIONAL ADD: A Repair - National Institute for A			ed Materials fo	or Materials Sul	ostitution and	0.0	000	1.295	0.000	0.000
(U)	In FY 2006: Not Applicable. In FY 2007: Conduct Congress for Materials Substitution and D	-				ed Materials					
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable. Total Cost						16.4	455	19.643	17.017	17.259
(U)	C. Other Program Funding S	<u>ummary (\$ in N</u>	<u>(fillions)</u>								
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	Total Cost
(U)	Related Activities:	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	
` '	PE 0603112F, Advanced Materials for Weapons										
(U)	Systems. PE 0603211F, Aerospace										
	Technology Dev/Demo.										
	This project has been										
	coordinated through the				D.4. Line House M.	. r					
					R-1 Line Item No	1.5					

Exhibit R-2a, RDT&E Pr	oject Justification	DATE February	ry 2007
UDGET ACTIVITY 2 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4349 Materials Technolo Sustainment	-
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>			
Reliance 21 process to			
harmonize efforts and eliminate duplication.			
J) <u><b>D. Acquisition Strategy</b></u>			
Not Applicable.			
	R-1 Line Item No. 5		(DE 0
Project 4349	Page-27 of 30 105	Exhibit R-2a	(PE 060210

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY plied Research					IBER AND TITL			OJECT NUMBE		echnology
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4915	Deployed Air Base Technology	5.855	5.740	2.580	2.324	2.727	2.755	2.813	2.885	Continuing	TBI
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
ך p	A. Mission Description and Budget This project develops new deployable protection and survivability of deployed ighting, and force protection to impro	airbase techno ed Air Expedit	ologies to redu ionary Force			•	-			-	
(U) 1 1 (U) 1 0 6 8 8 8	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop new deprequirements, setup times, and sustain in FY 2006: Investigated fabrication deployable shelter fabrics. Developed eatalysis for logistic fuel processing p expansion device to improve deployed stabilization agents for rapid airfield e capability to improve man-portable ra- similar effects as chemical catalysts for	loyable airbas ment costs in techniques to l advanced hea lanar technolo l air condition expansion. Re pid airfield as	te technologie support of AE integrate solid at and mass tra gy. Develope ing performan fined ground p sessment. Dev	F operations. state solar ce ansfer technol d an advance ice. Demonst penetrating ra- veloped biom	Il technology i ogies and thin d work-recove rated polymer- dar interpretati aterials that pr	into film ry rotary -clay ion	<u>FY 20</u> 1.2		<u>7 2007</u> 1.377	<u>FY 2008</u> 1.234	<u>FY 2009</u> 0.952
(U) I 1 1 1 1 2 2	In FY 2007: Develop high-efficiency mass transfer technologies and demon behavior of soil and stabilizer interact non-radar wave methods of nondestru materials using biocatalysts and reage perospace materials.	solar shelter f istrate logistic ion with airfie ctive inspection nts for produc	abrics. Contin fuel processin ld matting and on of airfield s ing reduced co	nue developm ag planar tech l begin model urface anoma ost, tailored cl	ent of advance nology. Invest development. lies. Synthesis haracteristics i	tigate Develop ze polymer n					
I I I	In FY 2008: Develop and analyze sol Reformer specification for acquisition investigate and evaluate high tempera Demonstrate nondestructive inspection effectiveness and performance of synt in FY 2009: Demonstrate advanced in	. Begin devel ture effects or n of airfield su hesized polyn	opment of adv operating sur urface evaluationer materials.	vanced integra faces and dev on technologi	ated power tech relop repair tech ies. Demonstr	hnologies. chnology. ate cost					
1 (U)	nigh temperature effects on operating airfield surface evaluation technologie	surfaces. Der		analyze nondo R-1	estructive insp I Line Item No. 5	ection of				Evhikit D. 20 (D	
Proje	ct 4915				Page-28 of 30 106					Exhibit R-2a (P	= 0002102F)

Exhibit R-2a, RDT&E I	Project Justification		DATI	February	2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials			ABER AND TITLE	Fechnology
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable protection and survivability to AEF deployed warfighters and infrast Congressional Add funding of \$3.5 million in FY 2006 (\$1.4 million Homeland Defense and \$2.1 million for Thermal Sprays for Structur million in FY 2007 (\$2.0 million for Blast Resistant Panels for Build \$1.1 million for Fire and Blast Resistant Materials for Force Protectic</li> </ul>	ructure. Note: This effort includes n for Blast Resistant Barriers for ral Blast Mitigation) and \$3.1 lings, Shelters, and Vehicles and	<u>FY 2006</u> 4.603	<u>FY 2007</u> 4.363	<u>FY 2008</u> 1.346	<u>FY 2009</u> 1.372
<ul> <li>(U) In FY 2006: Developed fire fighting agents with increased versatilit application methodologies. Developed technologies for increased fir improved synergy, and greater on-site duration. Researched resilien more effective protection of structures and inhabitants. Developed to ballistic and fragmentation effects of improvised explosive device the weapons threats. Modeled atmospheric and surface phenomenon of asymmetric threats for tailored response protection.</li> </ul>	y by combining agents and re fighter situational awareness, t infrastructure technologies for echnologies to protect against the rreats and characterize high energy				
(U) In FY 2007: Demonstrate emerging fire suppression technologies for Integrate individual fire fighter effectiveness technologies for a com Demonstrate resilient structural materials and methodologies for imp inhabitants. Continue developing technologies to protect against the of improvised explosive device threats, and initiate protective materi threats. Develop characterization data for atmospheric models for pu from asymmetric threats.	bined technology demonstration. broved protection of structures and ballistic and fragmentation effects al development against high energy				
(U) In FY 2008: Develop methodologies to characterize candidate fire s development of supporting fire suppression technologies for crash/re combined technologies for fire fighter effectiveness. Demonstrate as structural materials and methodologies for improved protection of st and analyze effectiveness of innovative improvised explosive defeat mechanisms of gas phase kinetics. Develop and evaluate accuracy for protection of deployed warfighters from asymmetric threats.	escue. Develop and evaluate nd analyze effectiveness of resilient ructures and inhabitants. Investigate and high energy threat. Investigate				
(U) In FY 2009: Develop and demonstrate methodologies to characteriz and continue to develop supporting fire suppression technologies for combined technologies for fire fighter effectiveness. Validate and de materials and methodologies for improved protection of structures and demonstrate effectiveness of innovative defeat of IED and high energy	crash/rescue. Develop and analyze emonstrate resilient structural nd inhabitants. Develop and gy threats. Expand evaluation				
Project 4915	R-1 Line Item No. 5 Page-29 of 30			Exhibit R-2a (I	

		Exhibit	R-2a, RD		t Justifica				DATE	February	2007
	GET ACTIVITY Applied Research				PE N	UMBER AND TI 2102F Materi			PROJECT NUMBE		
	<b>B. Accomplishments/Planned</b> development and demonstration of deployed warfighters from a Total Cost	on for wider varie	ty of compoun	ds for atmosph	neric models fo	r protection	<u>FY 2</u> 5.8	<u>006</u>	<u>FY 2007</u> 5.740	<u>FY 2008</u> 2.580	<u>FY 2009</u> 2.324
		······	(illiana)								
	<u>C. Other Program Funding S</u>	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	FY 2013 Estimate	Cost to Complete	LODAL COSE
(U)	Related Activities: PE 0603112F, Advanced Materials for Weapon										
(U)	Systems. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										
(U)	<b>D. Acquisition Strategy</b> Not Applicable.										
					R-1 Line Item No						
Pro	ject 4915				Page-30 of 30 108 JNCLASSIF					Exhibit R-2a (F	²E 0602102F)

#### PE NUMBER: 0602201F PE TITLE: Aerospace Vehicle Technologies

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
	T ACTIVITY Dlied Research					BER AND TITL D <b>1F Aerospa</b>	E Nce Vehicle <sup>-</sup>	Technologie		<b>-</b>	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	102.792	118.901	131.948	119.637	144.898	146.714	142.567	146.421	Continuing	TBD
22SP	Applied Space Access Vehicle Tech	0.000	3.797	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
2401	Structures	37.077	46.136	38.132	37.681	51.802	50.629	44.892	61.039	Continuing	TBD
2403	Flight Controls and Pilot-Vehicle Interface	26.753	37.269	37.501	33.765	37.196	39.375	38.475	37.574	Continuing	TBD
2404	Aeromechanics and Integration	38.962	31.699	56.315	48.191	55.900	56.710	59.200	47.808	Continuing	TBD
625030	n FY 2007, Project 6266SP, Applied , Applied Space Access Vehicle Tec . <b>Mission Description and Budget I</b>	hnology, in or	der to effectiv	•••				ultidisciplina	ry Space Tech	nology, Projec	t
· · _	nis program investigates, develops, a	nd analyzes a	erospace and a			U	1 0			s, and	

aeromechanics. Advanced structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Flight control technologies are developed and simulated for aerospace vehicles. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analysis. Resulting technologies reduce life cycle costs and improve the performance of existing and future manned and unmanned aerospace vehicles. Note: In FY 2007, Congress added \$2.4 million for Neurobiologically Autonomous Vehicle Operations, \$1.0 million for the Unmanned Air Vehicle Research, \$1.0 million for Sentient Adaptive Systems for Rapid Vehicle Condition-Based Maintenance, and \$2.2 million for Wight Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

#### (U) <u>B. Program Change Summary (\$ in Millions)</u>

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	104.469	112.751	106.517	111.837
(U) Current PBR/President's Budget	102.792	118.901	131.948	119.637
(U) Total Adjustments	-1.677			
(U) Congressional Program Reductions				
Congressional Rescissions	-0.003	-0.450		
Congressional Increases		13.100		
Reprogrammings	-0.298	-6.500		
SBIR/STTR Transfer	-1.376			
(U) Significant Program Changes:				
	R-1 Line Item No. 6 Page-1 of 21		Evhihit P	2 (PE 0602201F)
	109		EXHIDIC R-	2 (FE 0002201F)

Exhibit R	R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technolo	
Not Applicable. (U) C. Performance Metrics Under Development		
	R-1 Line Item No. 6 Page-2 of 21 110	Exhibit R-2 (PE 0602201F)

		Exhibit R-	2a, RDT&I	E Project	Justificati	on			DATE	February	2007
	ET ACTIVITY oplied Research				06022	MBER AND TIT 201F Aerosp 10logies	LE ace Vehicle	22	OJECT NUMBE SP Applied ch		ss Vehicle
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
22SP	Applied Space Access Vehicle Tech	0.000	3.797	0.000			0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
62503 Force (U) <u>4</u>	In FY 2007, Project 6266SP, Appli 0, Applied Space Access Vehicle To priorities. A. Mission Description and Budge This project develops technologies in Resulting technologies contribute sig warfighter include enhanced mission	echnology, in or <u>t Item Justifica</u> n areas of advar gnificantly towa	rder to effectiv ation nced structures ards the develo	, flight contro pment of reli	and provide ov ols, and aerody iable, responsi-	versight of the ynamics to ena ve space acces	efforts. In FY able affordable as systems with	2008, efforts on-demand n aircraft-like	were terminat nilitary access operations. Pa	to space.	
(U) (U) (U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop advance horizontal launch for affordable on- In FY 2006: Not Applicable. In FY 2007: Further define and dev vehicle performance envelope. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ced structure, fl demand military	ight control, a y access to spa	ce.	-		<u>FY 20</u> 0.0	_	<u>Y 2007</u> 3.797	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U)	Total Cost						0.0	00	3.797	0.000	0.000
(U) <u>(</u>	C. Other Program Funding Summ	<u>ary (\$ in Millio</u>	ons)								
(U) H (U) J (U) J	<u>H</u> Related Activies: PE 0603211F, Aerospace Fechnology Dev/Demo. D. Acquisition Strategy Not Applicable.			<u>PY 2008</u> Estimate	FY 2009 Estimate	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cos</u> t
Proje	ct 22SP			R-	1 Line Item No. Page-3 of 21 111	6				Exhibit R-2a (P	E 0602201F)

		Exhibit R-	2a, RDT&E	E Project	Justificatio	on			DATE	February 2	2007
	GET ACTIVITY pplied Research				06022	<pre>//BER AND TITL 01F Aerospa /ologies</pre>			OJECT NUMBE		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2401	Structures	37.077	46.136	38.132	37.681	51.802	50.629	44.892	61.039	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	U) <u>A. Mission Description and Budget Item Justification</u> This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new structural concepts and design techniques. New structural concepts include incorporating subsystem hardware items (e.g., antennas, sensors, directed energy weapon components, and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Resulting technologies strengthen and extend the life of current and future manned and unmanned aerospace vehicle structures, while providing increased capabilities. Payoffs to the warfighter include reduced weight and cost, as well as improved operability and maintainability of aerospace vehicles.										
(U) (U) (U)	<ul> <li>B. Accomplishments/Planned Program (\$ in Millions)</li> <li>B. Accomplishments/Planned Program (\$ in Millions)</li> <li>MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools,</li> <li>2.060</li> <li>2.120</li> <li>3.705</li> <li>3.593</li> <li>methodologies, and structural health monitoring schemes.</li> <li>In FY 2006: Continued to pursue additional aspects of the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Incorporated newly developed analysis tools into life prediction and failure analysis. Continued to refine failure criteria tools for advanced high temperature aircraft components and concepts.</li> </ul>										
(U)	In FY 2007: Continue development of to damage. Continue the development current and future aircraft, enhancing Incorporate newly developed analysis failure criteria tools for advanced high	t of economic capabilities, co tools into life	service life an omponent repl prediction and	alysis and str acement, and d failure analy	uctural design technology di vsis. Continue	tools for rection.					
(U) (U)	<ul> <li>failure criteria tools for advanced high temperature aircraft components and concepts.</li> <li>J) In FY 2008: Based upon results of demonstration efforts in PE 0603211F - Aerospace Technology Dev/Demo, refine development of structural health management schemes for structures susceptible to damage. Continue the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Continue the development analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts.</li> <li>J) In FY 2009: Continue development of structural health management schemes for structures susceptible to damage. Continue the development of structural health management schemes for structures susceptible</li> </ul>										
Proj	current and future aircraft, enhancing			acement, and R-1	U	rection.				Exhibit R-2a (P	E 0602201F)

	Exhibit R-2a, RDT&E Project	Justification		DATI	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies	e Vehicle	PROJECT NUN 2401 Struct	IBER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Continue the development analysis tools into life prediction and failure analysis failure criteria tools for advanced high temperature aircraft components and c	-				
(U)						
(U)	MAJOR THRUST: Develop methodologies to allow for analytical airworthin reduce the cost and time involved in actual full-scale testing of components an obtaining airworthiness certification.		6.886	7.293	3.716	3.314
(U)	In FY 2006: Continued development of medium- and high-fidelity, and real-t methodologies that improve airworthiness certification process and reduce de	-				
(III)	aircraft and components subject to dynamics loads. In FY 2007: Continue development of analytical certification methodologies	that incorporate advanced				
(U)	methods, concepts, diagnostic techniques, and manufacturing technologies int	-				
	components and airframe design. Complete development of medium- and his	0				
	analytical certification methodologies that improve airworthiness certification	•				
	development and testing for aircraft and components subject to dynamics load	1				
an	In FY 2008: Continue development of analytical certification methodologies					
(0)	methods, concepts, diagnostic techniques, and manufacturing technologies int	-				
	components and airframe design. Incorporate newly developed analysis in re-					
	certification methodologies that improve airworthiness certification process a	-				
	testing for aircraft and components subject to dynamics loads.	na reduce development and				
(U)	In FY 2009: Continue development of analytical certification methodologies	that incorporate advanced				
(0)	methods, concepts, diagnostic techniques, and manufacturing technologies int	-				
	components and airframe design. Initiate development of high-fidelity and co	• •				
	certification methodologies that improve airworthiness certification process a	-				
	testing for aircraft and components subject to dynamics loads.	nd reduce development and				
(U)	testing for anerart and components subject to dynamics loads.					
(U)	MAJOR THRUST: Develop design methods to capitalize on new materials a	nd integration of various	12.726	19.442	17.582	17.296
(0)	subsystem hardware items (e.g., antennas, sensors, direct energy weapon com	-	12.720	17.112	17.502	17.270
	energy storage) and adaptive mechanisms into the actual aircraft structures an					
	Note: In FY 2006 and out, funding increased due to initiation of full-scale fea					
	air vehicle monitoring in advanced structures. Efforts in this thrust are integra	•				
	2403 for advanced flight controls, components, and integrated vehicle health					
		R-1 Line Item No. 6				
Proi	ject 2401	Page-5 of 21			Exhibit R-2a (F	'는 0602201F)

	Exhibit R-2a, RDT&E Project Ju		DATE	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Ve Technologies	hicle	PROJECT NUM	IBER AND TITLE URES	
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2006: Continued development and initiated evaluation and assessment of de methods and components that enable the integration of structures with other air vel reduce cost and weight, as well as increase the survivability and performance of fu Initiated the development and analysis of critical subsystem hardware integration redirected energy weapons to be carried out on future air vehicles. Completed analysis feasibility determination of energy storage concepts that are integrated into load-be Continued the development and initiated evaluation, assessment, and ground evalu structures and antenna integration concepts into load-bearing structures to create multra-lightweight concepts.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2007: Continue the development, evaluation, and assessment of design and components that enable the integration of structures with other air vehicle function weight, as well as increase the survivability and performance of future systems. Codevelopment, evaluation, assessment, and ground testing of adaptive structures, sul and antenna integration into load-bearing structures to create multi-function or ultr concepts. Complete feasibility determination efforts of energy storage concepts th load-bearing structures. Complete the development and analysis, and initiate evalu critical subsystem hardware integration methods that enable directed energy weapor on future air vehicles. Initiate development, analysis, and evaluation of innovative integrate active aeroelastic design concepts, adaptive structures, and aerodynamic for technologies to enable viable long-range and long endurance air vehicle concepts.	s to reduce cost and ontinue the bsystem hardware, a-lightweight at are integrated into hation and testing of ons to be carried out technologies that				
(U)	In FY 2008: Continue the development, evaluation, and assessment of design and components that enable the integration of structures with other air vehicle function weight, as well as increase the survivability and performance of future systems. Condevelopment, evaluation, assessment, and ground testing of adaptive structures, suit and antenna integration into load-bearing structures to create multi-function or ultr concepts. Continue development, analysis, evaluation and simulation of innovative advance active aero elastic design concepts, adaptive structures, aerodynamic flow system health reasoners and active denial concepts. Initiate characterization of hig concepts. Initiate development, evaluation, and assessment of multi-functional struground demonstration of energy storage concepts, integrated distributed electronications integration systems.	s to reduce cost and ontinue the bsystem hardware, a-lightweight e technologies to control technologies, h energy laser actures to include				
Pro		e Item No. 6 je-6 of 21			Exhibit R-2a (	PE 0602201F)

	Exhibit R-2a, RDT&E Project Just	DAT	February	2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies	e Vehicle	PROJECT NUI 2401 Struct	MBER AND TITLE	
(U) (U)	In FY 2009: Continue the development, evaluation, and assessment of design and an components that enable the integration of structures with other air vehicle functions to weight, as well as increase the survivability and performance of future systems. Initic capabilities for conformal load bearing antenna structure. Continue the development assessment, and ground testing of adaptive structures, subsystem hardware, and anter load-bearing structures to create multi-function or ultra-lightweight concepts. Continu analysis, evaluation and simulation of innovative technologies to advance active aero concepts, adaptive structures, aerodynamic flow control technologies, system health denial concepts. Continue characterization of high energy laser concepts. Continue of evaluation, and assessment of multi-functional structural to include ground demonstr	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	storage concepts, integrated distributed electronics, and homogeneous sensor integrated	ion systems.				
(U) (U) (U) (U)	operate at an extreme altitude, while at sustained speeds greater than Mach 2. In FY 2006: Refined the development of technologies that incorporate advanced ma concepts for the creation of an integrated air vehicle structure that can withstand extr environments. Technologies will improve durability of existing and future aerospace resulting in reduced cost and increased life. Continued the development of concepts advanced, all weather, durable, thermal protection systems; attachment techniques; v management; joining concepts; and tanks.	tterials and design eme flight e vehicle structures germane to ehicle health esign concepts for vironments. res resulting in inced, all weather, ment; hot primary esign concepts for vironments. res resulting in	15.405	17.281	13.129	13.478
Pro		Item No. 6 7 of 21			Exhibit R-2a (	PE 0602201F)
		15	U Constantino de la constantino de la constantino de la constantino de la constantino de la constantino de la c			/

	Exhibi	: R-2a, RD1	T&E Projec	t Justifica	tion			DATE	February	2007	
BUDGET ACTIVITY 02 Applied Research				0602					DJECT NUMBER AND TITLE D1 Structures		
<ul> <li>(U) <u>B. Accomplishments/Plan</u></li> <li>(U) In FY 2009: Further developments of an integrated the creation of an integrated Technologies will improve reduced cost and increased for design and evaluation of the second</li></ul>	p technologies that air vehicle structur durability of existin life. Incorporate ne	incorporate ad e that can with g and future ae wly developed	stand extreme crospace vehicl	flight environn e structures res	nents. sulting in	<u>FY 2</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) Total Cost						37	077	46.136	38.132	37.681	
<ul> <li>(U) C. Other Program Funding</li> <li>(U) Related Activities:</li> <li>(U) PE 0602102F, Materials.</li> <li>(U) PE 0603112F, Advanced Materials for Weapon Systems.</li> <li>(U) PE 0603211F, Aerospace Technology Dev/Demo.</li> <li>(U) PE 0604015F, Next Generation Bomber.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>	<u>g Summary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions</u> ) <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate		I OTAL COST	
(U) <u>D. Acquisition Strategy</u> Not Applicable. Project 2401				R-1 Line Item No Page-8 of 21	D. 6				Exhibit R-2a (		

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY oplied Research				06022	IBER AND TITL 01F Aerospa Iologies		24	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2403	Flight Controls and Pilot-Vehicle Interface	26.753	37.269	37.501	33.765	37.196	39.375	38.475	37.574	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
Note:	In FY 2006 and out, increased fundir	ng is due to ind	creased empha	sis being plac	ced on incorpo	rating data fro	om air vehicle	monitoring co	omponents into	o flight contro	ls.
2 5 2 5	A. Mission Description and Budget Item Justification This project develops technologies that enable maximum affordable capability from manned and unmanned aerospace vehicles. Advanced flight control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous unmanned air vehicles, space access systems with aircraft-like operations, and extended-life legacy aircraft. Payoffs to the warfighter include enhanced mission effectiveness, optimized flight safety, increased survivability, improved maintenance, and decreased size, weight, and cost. Leverages a network of synthetic environments for evaluation of advanced concepts.										
	<b>B. Accomplishments/Planned Progr</b>						<u>FY 20</u>		<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop advance nealth monitoring systems for both ma efforts will also focus on reducing the Increased funding in FY 2006 and out from air vehicle monitoring component in FY 2006: Furthered the development eechnologies to provide highly reliable environments at significantly reduced technologies for adverse environments maintainability. Designed systems for Continued to develop and assess tools complex, adaptive, and autonomous c extend design-time verification and va- systems for enhanced assurance. Con techniques for unmanned system situa- real-time fault compensation for aeros development and evaluation of novel to aerospace vehicles.	anned and unr size, weight, t, is due to incr ints into the flig ent and assessive operations for size, weight, as that reduce size s that reduce size ontrol softwar alidation of int tinued the eva ational awaren space vehicles flight control of	nanned aircraft and cost of co- reased emphas ght control sys- ment of advan- or manned and and cost. Dev ubsystem size al control using s for the afforce e. Developed celligent, autor luation of sens- ess in airspace using integrat	t. In addition ntrol and prog is being place stems. ced control m unmanned sy eloped high-d , weight, and g high-density lable validation technologies nomous, and r sing and associ- ed health mar istributed actu	a to increased r gnostic system ed on incorpor- nechanization ystems under a lensity optical cost, while con- y optical comp on and verifica and analysis to reconfigurable ciated interpret Continued to en nagement. Con- uation and mor	eliability, s. Note: ating data dverse component nsidering onents. tion of ools to control tation enhance ntinued the rphing	9.5		16.145	20.752	18.380
(U) 1	In FY 2007: Further the development	and assessme	ent of advance		1 Line Item No. 6	C					
Proje	ct 2403				Page-9 of 21					Exhibit R-2a (P	E 0602201F)
					117						

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies	e Vehicle		BER AND TITLE Controls and Interface		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> to provide highly reliable operations for manned and unmanned systems under significantly reduced size, weight, and cost. Develop high-density optical comp adverse environments that reduce subsystem size, weight, and cost while conside Design systems for safety-critical control using high-density optical component and assess tools and processes for the affordable validation and verification of c autonomous control software. Refine technologies and analysis tools for recor- systems. Complete the evaluation of sensing and associated interpretation tech system situational awareness in aerospace operations. Refine technologies that health management.	ponent technologies for lering maintainability. s. Continue to develop complex, adaptive, and figurable control uniques for unmanned	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	In FY 2008: Further the development and assessment of advanced control mec to provide highly reliable operations for manned and unmanned systems under significantly reduced size, weight, and cost. Complete development of high-der technologies for adverse environments that reduce subsystem size, weight, and maintainability. Complete systems design for safety-critical electromagnetic tol the assessment of enhanced tools and processes for the affordable validation an complex, adaptive, and autonomous control software. Complete refinement of a compensation technologies for integrated vehicle health management.						
	significantly reduced size, weight, and cost. Initiate development of control arc to enable design for certification to ease validation and verification for complex systems. Initiate development of low-maintenance/fault tolerant control-effector aerospace applications.	hitecture enhancements and adaptive unmanned					
(U) (U)	MAJOR THRUST: Develop flight control systems that will permit safe interop manned aircraft and unmanned aircraft. Concepts will also provide mission res adaptability for improved operational effectiveness of manned and unmanned s 2006 and out, increased funding is due to increased emphasis being placed on d for small air platforms operating in an urban environment.	ponsiveness and ystems. Note: In FY eveloping flight controls	4.506	9.783	9.817	8.665	
(U)	In FY 2006: Assessed novel control automation techniques and adaptive algori interoperable application of manned and unmanned aerospace systems. Contin	ued to enhance reliability					
Pro		Line Item No. 6 Page-10 of 21			Exhibit R-2a (P	PE 0602201F)	

	Exhibit R-2a, RDT&E Project Just		DATE	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies	e Vehicle		MBER AND TITLE Controls and e Interface	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> and performance analysis of self-organizing, distributed control of multi-unmanned v formations.	ehicle flight	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Continue to develop and assess novel control automation techniques an algorithms to enable safe and interoperable application of manned and unmanned aer Continue to enhance reliability and performance analysis of self-organizing, distribut multi-unmanned vehicle flight formations. Initiate development and assessment of c techniques for close-in surveillance of urban environments. Initiate control and situa requirements development for interoperability of unmanned vehicles in terminal area operations.					
(U)	In FY 2008: Continue to develop and assess novel control automation techniques an algorithms to enable safe and interoperable application of manned and unmanned aer Continue to enhance reliability and performance analysis of self-organizing, distribut multi-unmanned vehicle flight formations. Continue development and assessment of techniques for close-in surveillance of urban environments. Complete control and sin requirements development for interoperability of unmanned vehicles in terminal area operations. Develop and assess adaptive guidance and control technologies for fault/ aerospace vehicle operations.					
(U) (U)	In FY 2009: Continue to develop and assess novel control automation techniques an algorithms to enable safe and interoperable application of manned and unmanned aer Complete reliability and performance analysis of self-organizing, distributed control vehicle flight formations. Complete development and assessment of cooperative con close-in surveillance of urban environments. Initiate technology development for int unmanned vehicles in terminal area and ground operations. Continue to develop and guidance and control technologies for fault/damage tolerant aerospace vehicle operation.	ospace systems. of multi-unmanned trol techniques for eroperability of assess adaptive				
(U)	MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based	research and	5.997	6.958	6.932	6.720
(U)	development of future aircraft. In FY 2006: Conducted assessments of advanced manned and unmanned aerospace simulated future environments. Conducted analysis of future strike concepts in a 202 environment. Continued analysis of long endurance intelligence, surveillance, and re platforms in a network centric environment. Continued to support simulation activities	20+ virtual econnaissance				
Pro		tem No. 6 1 of 21			Exhibit R-2a (F	PE 0602201F)
		19			(	

	Exhibit R-2a, RDT&E Project Just	DATE	February	2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies		PROJECT NUM 2403 Flight ( Pilot-Vehicle		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> transports and future tankers. Supported the analysis of new concepts in hostile urba missions requiring aircraft-like access to space.	n environments and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Complete assessments of advanced manned and unmanned aerospace of simulated future environments. Complete analysis of long endurance intelligence, su reconnaissance platforms in a network centric environment. Conduct technology tradigeneration theater transports. Conduct the analysis of new concepts in access to space conduct analyses of new concepts in hostile urban environments.					
(U)	In FY 2008: Refine network-centric environment to broaden advanced technology a capability. Expand breadth of simulation analyses in refined net-centric environment multi-directorate technology trade studies for refined long-range strike and reconnais Continue technology trade studies for next generation theater transports. Conduct sin analyze advanced launch and reentry technologies for access-to-space concepts. Cor trade studies of small and medium sized unmanned air vehicles in hostile urban environment.					
(U)	In FY 2009: Refine network-centric environment to broaden advanced technology a capability. Expand breadth of simulation analyses in refined net-centric environmen multi-directorate technology trade studies for refined long-range strike and reconnais Continue technology trade studies for next generation theater transports. Conduct sin analyze advanced launch and reentry technologies for access-to-space concepts. Corr trade studies of small and medium sized unmanned air vehicles in hostile urban environment.	ssessment t to address sance concepts. nulations to tinue technology				
(U) (U) (U)	CONGRESSIONAL ADD: Intelligent Flight Control Simulation Research. In FY 2006: Continued Congressionally-directed effort for intelligent flight control s laboratory.	simulation research	0.973	0.000	0.000	0.000
(U) (U) (U) (U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.					
(U) (U)	CONGRESSIONAL ADD: Sentient Adaptive Systems Technology for Vehicle Con Maintenance. In FY 2006: Initiated Congressionally-directed effort for sentient adaptive systems vehicle condition-based maintenance.		1.653	0.996	0.000	0.000
Pro	ject 2403 Page-	Item No. 6 12 of 21 20	_		Exhibit R-2a (I	PE 0602201F)

Exhibit R-2a, RDT&E Pro	ject Justification		DATE	DATE February 2007			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLI 0602201F Aerospa Technologies			IBER AND TITLE Controls and	2007		
(U) <b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) In FY 2007: Continue Congressionally-directed effort for sentient adapt	tive systems technology for						
vehicle condition-based maintenance.							
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
		1.650	0.000	0.000	0.000		
(U) CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integra	tion and Technology	1.653	0.000	0.000	0.000		
Evaluation. (U) In FY 2006: Initiated Congressionally-directed effort for rapid integration	on and tachnology avaluation						
<ul><li>(U) In FY 2006: Initiated Congressionally-directed effort for rapid integration</li><li>(U) In FY 2007: Not Applicable.</li></ul>	on and technology evaluation.						
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
(U)							
(U) CONGRESSIONAL ADD: Unmanned Systems Initiative for Army Mis	ssile Research. Development.	2.464	0.000	0.000	0.000		
Engineering Center (AMRDEC).		2	0.000	0.000	0.000		
(U) In FY 2006: Initiated Congressionally-directed effort for unmanned sys	tems initiative for AMRDEC.						
(U) In FY 2007: Not Applicable.							
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
(U)							
(U) CONGRESSIONAL ADD: Neurobiologically Autonomus Vehicle Ope	rations	0.000	2.391	0.000	0.000		
(U) In FY 2006: Not Applicable.							
(U) In FY 2007: Initiate Congressionally-directed effort for neurobiological	ly autonomus vehicle						
operations.							
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
		0.000	0.005	0.000	0.000		
(U) CONGRESSIONAL ADD: Unmanned Air Vehicle Research		0.000	0.996	0.000	0.000		
(U) In FY 2006: Not Applicable.	-hi-l- manageh						
<ul><li>(U) In FY 2007: Initiate Congressionally-directed effort for unmanned air v</li><li>(U) In FY 2008: Not Applicable.</li></ul>	enicie researcn.						
<ul><li>(U) In FY 2008: Not Applicable.</li><li>(U) In FY 2009: Not Applicable.</li></ul>							
(0) In Fi 2007. Not Applicable.							
	R-1 Line Item No. 6						
Project 2403	Project 2403 Page-13 of 21						

	Exhibit R-2a, RDT&E Project Justification February 2007										
BUDGET ACTIVITY 02 Applied Research				PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies				PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface			
(U) <u>B. Accomplishments/Planned I</u> (U)	Program (\$ in	<u>Millions)</u>				<u>FY 2</u>	<u>006 I</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) Total Cost						26.	753	37.269	37.501	33.765	
(U) <u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u>	<u>/lillions)</u>									
(U) Related Activities:	<u>FY 2006</u> <u>Actual</u>	FY 2007 Estimate	FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>	
(U) PE 0602202F, Human Effectiveness Applied Research.											
(U) PE 0602204F, Aerospace Sensors.											
(U) PE 0603211F, Aerospace											
Technology Dev/Demo. (U) PE 0604015F, Next											
Generation Bomber.											
(U) This project has been											
coordinated through the Reliance 21 process to											
harmonize efforts and											
eliminate duplication.											
(U) <u>D. Acquisition Strategy</u> Not Applicable.											
				R-1 Line Item No							
Project 2403				Page-14 of 21 122					Exhibit R-2a (F	'E 0602201F)	
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		Exhibit R-	2a, RDT&E	E Project	Justificatio	on			DATE	February 2	2007	
	ET ACTIVITY pplied Research					IBER AND TITL 01F Aerospa ologies			PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration			
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
2404	Aeromechanics and Integration	38.962	31.699	56.315	48.191	55.900	56.710	59.200	47.808	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0			
; ; ; ; ;	This project develops aerodynamic configurations of a broad range of revolutionary, affordable air vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction, and integrates and demonstrates multi-disciplinary advances in airframe, propulsion, weapon, and air vehicle control integration. Technologies developed will greatly enhance warfighter capability in aircraft, missiles, and high-speed aerospace vehicles. The payoffs from these technology programs include lower vehicle costs (both production, and operations and support costs), increased payload and range capability, and improved supportability, safety, and survivability of aerospace vehicles.											
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions)       FY 2006       FY 2007       FY 2008       FY 2009         J)       MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design       4.839       3.402       4.061       3.226         capabilities of manned and unmanned air vehicles.       FY 2006       FY 2007       FY 2008       FY 2009											
	In FY 2008: Continue efforts to deve unmanned air vehicles in future missi decrease human risk. Continue to per vehicle concept to perform tactical su evaluation of flow control techniques improved propulsion system performa	ons, including form mission rveillance and to complex air	offensive mis assessment an weapon delive vehicle desig	sions, to reduce d develop low ery. Continue fins to achieve	ce life cycle co v-cost unmann e development reduced drag	osts and ed air and and						
Proje	ect 2404				Line Item No. 6 Page-15 of 21 123					Exhibit R-2a (P	E 0602201F)	

	Exhibit R-2a, RDT&E Project J	lustification		DATE	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies	e Vehicle		IMBER AND TITLE mechanics and Integration		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> thrust vectoring concept for unmanned air vehicle. Continue to develop technol weapon delivery and propulsion system performance in unmanned air vehicles.	ogies for improved	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Continue efforts to develop and assess aeronautical technologies the unmanned air vehicles in future missions, including offensive missions, to reduce decrease human risk. Continue to perform mission assessment and develop low vehicle concept to perform tactical surveillance and weapon delivery. Initiate de innovative aerodynamic control methods for small unmanned air vehicles. Refin fluid-based thrust vectoring concept for unmanned air vehicle. Continue to deve improved weapon delivery and propulsion system performance in unmanned air	e life cycle costs and -cost unmanned air evelopment of ne development of lop technologies for					
(U) (U)	MAJOR THRUST: Develop new and improved concepts, designs, and analysis enable revolutionary capabilities for sustained high-speed flight and re-useable h vehicle efforts. Note: In FY 2006 and out, increased emphasis has been placed generation long-range, high-speed air vehicle concepts. Note: Provide support t effort (Energy Conservation - Assured Fuels Initiative ) to identify and develop provide revolutionary aircraft configurations that enable the use of domestic fue energy needs.	of technologies to high altitude aerospace on assessing the next o SECAF directed technologies that	18.143	16.373	26.931	19.758	
(U)	In FY 2006: Continued development and assessment of aerospace technologies high-speed flight to permit global reach. Continued development of integrated a design concepts for high-speed aerospace vehicles. Conducted computational ae sub-scale aerodynamic testing of advanced inlet boundary layer flow control tec devices, and high-speed inlet apertures. Conducted computational aerodynamic performance vectoring exhaust nozzles. Continued development of analytic me plasma flow field over high-speed vehicles to significantly reduce drag. Conduc aerodynamic analysis of high efficiency wing-body aero configurations includin control techniques.	airframe propulsion erodynamic analysis and hniques, secondary flow analysis of high ethods for modeling the cted computational					
(U)	In FY 2007: Continue development and assessment of aerospace technologies the high-speed flight to permit global reach. Continue development of integrated air design concepts for high-speed aerospace vehicles. Conduct sub-scale aerodyna inlet concepts on high efficiency aero configurations for system level performant and analyze thermally integrated structures for lightweight integrated exhaust system.	rframe propulsion mic testing of integrated ice validation. Develop estems and airframes.					
		Line Item No. 6 Page-16 of 21			Exhibit R-2a (I		

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602201F Aerospace Technologies	e Vehicle		IBER AND TITLE echanics and	
Conduct high fidelity aero operation. Develop analyt Complete development of to significantly reduce drag	-	n level operability. over high-speed vehicles	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U) In FY 2008: Continue devining high-speed flight to permit design concepts for high-speed flight to permit design concepts for high-speed optimization technologies the Initiate efforts to integrate sub-scale aerodynamic integrate sub-scale aerodynamic integrate sub-scale aerodynamic integrate sub-scale aerodynamic integration. Val Note: Provide support to Sidentify and develop techn of domestic fuel sources for (U) In FY 2009: Continue devinigh-speed flight to permit design concepts for high-speed conter multi-spectrum system initiate study of exhaust system initiate study of exhaust system initiate study of exhaust system initiate study of exhaust system initiate study of exhaust system initiate study of exhaust system is conterned. Note: Provide initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration initiative is to identify and iteration iteration initiative is to identify and iteration iter</li></ul>	velopment and assessment of aerospace technologies is global reach. Continue development of integrated a peed aerospace vehicles. Initiate study of energy-bas r vehicle design. Evaluate supersonic tailless aerodyn ersonic phenomena and develop and validate fundam arough experimental flight techniques in a relevant his self-defense systems to counter multi-spectrum syste egrated inlet concepts on high efficiency aero configu- ermally integrated structures for lightweight integrate fidelity aerodynamic testing of advance control techr idate analytical stability and control simulations for s SECAF directed effort (Energy Conservation - Assur ologies that provide revolutionary aircraft configurat	irframe propulsion sed analysis and namic concepts. Initiate nental hypersonic igh-speed environment. em threats. Evaluate urations for system level ed exhaust systems and hiques for low-speed and system level operability. red Fuels Initiative ) to tions that enable the use that enable sustained hirframe propulsion e self-defense systems to att control development. haterials and fluid layer interaction control. c cold-flow testing of sub d develop and validate echniques in a relevant rvation - Assured Fuels				
(U)						
Project 2404		1 Line Item No. 6 Page-17 of 21 125			Exhibit R-2a (	PE 0602201F)

	Exhibit R-2a, RDT&E Project Just	ification		DATE	E February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospa Technologies			MBER AND TITLE	
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> MAJOR THRUST: Develop new and improved concepts, designs, and analysis of te enable revolutionary capabilities for re-useable, high altitude aircraft. Note: The FY efforts will be leveraging the results of the high-speed Major Thrust area previously	2006 and FY 2007	<u>FY 2006</u> 5.119	<u>FY 2007</u> 1.842	<u>FY 2008</u> 6.717	<u>FY 2009</u> 7.324
(U)		enable high-speed evaluation of control the flow flight environments.				
(U)		ental, and analytical -speed aerospace of techniques to				
(U)	· · ·	es for high-speed ying aerothermal at high-speeds. ace-access aircraft.				
(U)	In FY 2009: Continue development and assessment of aerospace technologies that e space-access aircraft. Enhance robust design methodology and integration approach aeropropulsion. Continue extensive application and 3D validation experience in app computational tools to conceptual, ground-tested and flight-tested vehicles traveling Refine unique high temperature structures and materials in support of high speed re- aircraft. Continue multi-disciplinary optimization of complex high-speed, high temp vehicles. Initiate design and test of components of integrated high-speed space-acce system.	nable reusable, es for high-speed lying aerothermal at high-speeds. usable space-access erature, reusable air				
(U)						
(U)	MAJOR THRUST: Develop enabling technologies to allow integration of directed of	energy weapons into	3.556	1.789	2.278	1.108
Pro		Item No. 6 18 of 21			Exhibit R-2a (F	PE 0602201F)
	1	26				

	Exhibit R-2a, RDT&E Proje	ct Justification		DATE	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies	0602201F Aerospace Vehicle			IMBER AND TITLE mechanics and Integration	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	current and future air vehicle platforms. In FY 2006: Continued development and evaluation of critical aeronautical directed energy weapons to be carried on future air vehicles, including man	euvering fighter aircraft, to					
	improve combat effectiveness. Completed analysis of tactical utility of high aircraft. Continued measurements of the actual aero-optics effects encounted weapon on a fighter aircraft.						
(U)	In FY 2007: Complete development and evaluation of critical aeronautical directed energy weapons to be carried on future air vehicles, including man improve combat effectiveness. Complete measurements of the actual aero-	euvering fighter aircraft, to					
(U)	when employing a laser weapon on a fighter aircraft. In FY 2008: Initiate development of combined flow control and adaptive o directed energy system performance on large low speed aircraft. Initiate de for predicting the performance of advanced flow control and adaptive optic	evelopment of analysis tools					
(U)	In FY 2009: Continue development of combined flow control and adaptive optic directed energy system performance on large low-speed aircraft. Continue tools for predicting the performance of advanced flow control and adaptive preliminary design of beam control systems for large scale demonstration.	e optics systems to optimize development of analysis					
(U)	premimary design of beam control systems for large scale demonstration.						
(U)	MAJOR THRUST: Develop and assess technologies for the next generatio Note: In FY 2008 and out, investment is increasing due to higher Air Force large aircraft.	•	4.971	6.101	16.328	16.775	
(U)	In FY 2006: Continued to develop and assess aeronautical technologies inc transonic, and structural designs that enable revolutionary tanker and transp global mobility. Continued to develop technologies that enable multiple ro	port aircraft designs for rapid					
(U)	and support aircraft. In FY 2007: Further development and assessment of aeronautical technology systems, transonic, and structural that enable revolutionary tanker and trans	gies including high lift					
	global mobility. Continue to develop technologies that enable multiple role and support aircraft.						
(U)	In FY 2008: Continue development and assessment of aeronautical technol systems, transonic, and structural concepts that enable revolutionary tanker						
Pro	ject 2404	R-1 Line Item No. 6 Page-19 of 21			Exhibit R-2a (I	PE 0602201E)	

	Exhibit R-2a, RDT&E Projec	Exhibit R-2a, RDT&E Project Justification							
	T ACTIVITY plied Research	PE NUMBER AND TITLE 0602201F Aerospac Technologies			JMBER AND TITLE mechanics and Integration				
fo de hi pl	<b>Accomplishments/Planned Program (\$ in Millions)</b> or rapid global mobility. Continue to develop technologies that enable mult elivery and support aircraft. Initiate trade studies between short take-off an igh-speed cruise. Initiate development of inlet and integration technologies latform designed to operate efficiently at transonic speeds and provide shor n FY 2009: Continued development and assessment of aeronautical technol	d landing performance, and for an advanced mobility t take-off capabilities.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
sy fo de pe ac	ystems, transonic, and structural concepts that enable revolutionary tanker a pr rapid global mobility. Continue to develop technologies that enable mult elivery and support aircraft. Optimize configuration for trade-off between s erformance, and high speed cruise. Continue development of inlet and inte- dvanced mobility platform designed to operate efficiently at transonic speed apabilities.	and transport aircraft designs tiple roles and missions for short take-off and landing gration technologies for an							
(U) In	CONGRESSIONAL ADD: Unique Stealth Unmanned Air Vehicle Houck A n FY 2006: Continued Congressionally-directed effort for unique stealth ur ircraft design program.		1.361	0.000	0.000	0.000			
(U) In	n FY 2007: Not Applicable. n FY 2008: Not Applicable. n FY 2009: Not Applicable.								
(U) C E	CONGRESSIONAL ADD: Wright Brothers Institute (WBI) - Characterizati nvironment for Tactical Lasers.		0.973	2.192	0.000	0.000			
er (U) In	<ul> <li>n FY 2006: Initiated Congressionally-directed effort for WBI - characterizanvironment for tactical lasers.</li> <li>n FY 2007: Continue Congressionally-directed effort for WBI - characterizanvironment for tactical lasers.</li> </ul>								
(U) In (U) In	n FY 2008: Not Applicable. n FY 2009: Not Applicable.								
(U) (U) To	otal Cost		38.962	31.699	56.315	48.191			
Droiget	t 2404	R-1 Line Item No. 6 Page-20 of 21			Exhibit R-2a (I				

	Exhibit	: R-2a, RD1	&E Projec	t Justifica	tion			DATE	ebruary 2007
BUDGET ACTIVITY 02 Applied Research				0602	UMBER AND TI 2 <b>201F Aeros</b>   hnologies	TLE pace Vehicle		OJECT NUMBEI 04 Aeromecl	R AND TITLE
(U) <u>C. Other Program Funding Sumn</u>	<u>nary (\$ in N</u>	<u>fillions)</u>							
	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u> <u>Total Cost</u>
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0603211F, Aerospace Technology Dev/Demo.</li> <li>(U) PE 0604015F, Next Generation Bomber.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>									
(U) <u>D. Acquisition Strategy</u> Not Applicable.									
Project 2404				R-1 Line Item No Page-21 of 21					Exhibit R-2a (PE 0602201F)
				129					

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#### PE NUMBER: 0602202F PE TITLE: Human Effectiveness Applied Research

	Ex	hibit R-2,	RDT&E B	udget Item	n Justifica	tion			DATE	February 2	2007
	T ACTIVITY Dlied Research					IBER AND TITL		s Applied R	-		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	111.369	109.174	79.856	79.377	94.344	85.960	88.339	92.936	Continuing	TBD
1123	Warfighter Training	16.992	20.247	13.024	13.850	14.160	14.620	14.929	15.271	Continuing	TBD
7184	Decision Effectiveness & Biosciences	68.731	62.682	48.597	47.368	60.812	53.080	55.151	58.978	Continuing	TBD
7757	Bioeffects and Protection	25.646	26.245	18.235	18.159	19.372	18.260	18.259	18.687	Continuing	TBD
th fo Ey m M	edict and mitigate the biological efferereats on personnel and mission perforr Bio Medical DNA Program, \$1.3 n yewear Display for Battlefield Opera illion for COM Attitude Control Syst aximizing Human Performance. This ility of evolutionary and revolutionar	rmance. Note hillion for Bat tions, \$1.0 mi tem Simulatio s program is i	: In FY 2007 tlefield Auton llion for Unma n/Trainer, \$4. n Budget Acti	, Congress add natic Life Stat asking Decept 3 million for S	ded \$2.0 millio us Monitor, \$1 ion and Denia Solid Electroly	on for AIRPR 1.0 million for 1, \$1.0 millior /te Oxygen Se	INT, \$1.6 mill Miniature Tri for Networke parator, and \$	ion for C4ISF -Axial Accele ed Warfighter 1.0 million for	R Fusion Syste crometer, \$1.0 Decision Sup r Warfighter S	em, \$1.0 millio million for port, \$1.1 Sustainability:	'n
(U) <u>B</u>	Program Change Summary (\$ in )	<u>Millions)</u>									
						<u>FY 20</u>		<u>FY 2007</u>		2008	<u>FY 2009</u>
	evious President's Budget urrent PBR/President's Budget					108.1 111.3		92.991 109.174		0.574 9.856	84.135 79.377
	otal Adjustments					3.1		109.174	,	7.830	19.311
. ,	ongressional Program Reductions					5.1	20	-0.005			
	ongressional Rescissions					-0.0	74	-0.413			
	ongressional Increases							14.500			
Re	eprogrammings					4.7	34	2.101			
	BIR/STTR Transfer					-1.4	-62				
(U) <u>Si</u>	gnificant Program Changes:										
					Line Item No. 7 Page-1 of 28	,				Exhibit R-2 (Pf	

Exhibit R-2, R	DT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY <b>02 Applied Research</b>	PE NUMBER AND TITLE 0602202F Human Effectivenes	
Not Applicable.		
C. Performance Metrics		
Under Development.		
	R-1 Line Item No. 7	
	Page-2 of 28	Exhibit R-2 (PE 0602202F)

		Exhibit R-2	2a, RDT&E	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY pplied Research				06022	IBER AND TITL 02F Human ed Research	Effectivenes		OJECT NUMBE		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	· · · ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
1123		16.992	20.247	13.024	13.850	14.160	14.620	14.929	15.271	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	<b>A. Mission Description and Budget</b> This project identifies and analyzes net training; mission rehearsal; training in spectrum of new and advanced technol cognitive and neural sciences with info simulation technologies to achieve ma readiness by providing more effective personnel at a reduced cost.	ew methods and a support of con- ologies to design ormation techr aximum learnir	d technologies nplex decision n and implem nology to creat ng effectivenes	n-making; info ent training, a te desktop tuto ss for specific	ormation warfa and to evaluate ors, coursewar needs at minin	are training; a training effect e developmen mum cost. Th	nd warfighter ctiveness. It c t tools and tec nese technolog	readiness trai ombines fund chnologies, as gies and metho	ning. It inves amental know sessment methods will increa	tigates the ledge from the nodologies, and use operational	e d
(U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Research percept simulation technologies to enhance D environments. Research identifies the mission rehearsal, allowing Air Force In FY 2006: Researched and analyze simulation in DMO multifaceted simu helmet-mounted, and out-the-window training. Identified, researched, and r generation deployable visual simulation displayed devices	tual issues invo istributed Miss e visual require warfighters to d human factor ilator displays. visual simulat esolved head-r	olving the deve sion Operation ements necessa train as they and perceptu Evaluated ar cion systems for nounted and d	ns (DMO) and ary for realisti- intend to fight al issues for co- nd researched or air-to-ground leployable dis	l decision dom ic aircrew trair t. off-boresight ta techniques for nd and compos play issues for	inance hing and regeting cockpit, site force next	<u>FY 20</u> 1.3		<u>¥ 2007</u> 2.693	<u>FY 2008</u> 1.603	<u>FY 2009</u> 2.051
(U) (U)	display devices. In FY 2007: Research and analyze kee display technologies including resolut accuracy, and transport delay. Perfor displays. Research and evaluate visua training. In FY 2008: Research perceptual issu systems that will allow for greater rea for new deployable visual display tech requirements for a fully immersive co	tion, image sta m human train al system requi ues for out-the- listic composit hnologies. Exp	bility, target tr ing research o rements for ai window displ the force trainir pand human fa	acking databa f head-mount r-to-ground a ay and targeti ng. Explore p actors visual r	ase characteris ed and deploya nd composite ng pod simula erceptual chara	tics, able force tion acteristics					
Proje	ect 1123				Line Item No. 7 Page-3 of 28 133	,				Exhibit R-2a (P	E 0602202F)

	Exhibit R-2a, RDT&E Proj	DATI	February	2007		
	T ACTIVITY plied Research	PE NUMBER AND TITLE 0602202F Human E Applied Research	ffectiveness		JMBER AND TITLE ighter Training	
(U) Ir ai di di ar te	<b>3. Accomplishments/Planned Program (\$ in Millions)</b> n FY 2009: Complete human factors research, tests, and evaluations of v ir-to-ground and air-to-air composite force training. Conduct perceptual lisplay concepts and components. Identify and analyze engineering and p lisplay concepts for a fully multi-modal immersive environment for DMC reas for training simulation and visual systems applications, and identify echnology issues.	l evaluations of deployable perceptual performance visual O. Examine all AF mission	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
in fc gy al id er T	MAJOR THRUST: Research and analyze tools, strategies, and performant mproving combat mission training, rehearsal, and operations for aircrews orces. Research provides the combat air forces and global strike operation uidelines for improving learning in training. Enhances the quality, mana- ll aspects of DMO, live operations training, rehearsal and exercise enviro dentification and application of competency-based training methods. Re- mable DMO and mission rehearsals to run new, complex models/simulation this research will provide vastly improved synthetic forces and aircraft si- eature high fidelity electronic warfare, aerodynamic, and weapons effect epresent the actual capabilities of both current and future systems and thr	s and command and control ons with the empirical data and agement, and effectiveness of onments through the esearch technologies that will ions at real- or near real-time. imulator capabilities that models that accurately	8.345	9.441	8.037	8.180
(U) Ir A er tr pl	n FY 2006: Evaluated integrated learning and readiness assessment mod Assessed usability of exemplar DMO training scenario design tool. Explo environment training syllabi capable of tailoring to individual needs. Inver- raining environments, with realistic, interactive visual scenery that can be platforms. Analyzed how spin-up time after brief and extended delays ca- eality training.	lels, data, and specifications. ored and evaluated virtual estigated fully immersive e adapted by multiple				
(U) Ir op cc in in th pl	n FY 2007: Evaluate capability to assess learning and proficiency within operational contexts. Identify metrics and develop preliminary guidelines continuation training and rehearsal. Identify common competency require nstructional designs for common training requirements across operationa mmersive, just-in-time training environments, with realistic, interactive c hat can be adapted for use within and across missions. Create a learning plan for integrating full fidelity training and rehearsal systems with more raining, rehearsal, and exercise environments.	s for initial, refresher, and ements and evaluate al mission areas. Analyze fully content and training strategies management-based migration				
Droioo	xt 1123	R-1 Line Item No. 7 Page-4 of 28			Exhibit R-2a (	PE 0602202E)

	Exhibit R-2a, RDT&E Project Jus	tification		DATI	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Eff Applied Research	ectiveness		ABER AND TITLE		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	In FY 2008: Evaluate approaches and tools for integrating principles of learning in constructive environments. Identify methods and tools to manage learning in operat contexts. Identify and analyze methods of routinely assessing knowledge and skills readiness. Analyze field data to identify opportunities for competency-based trainin Analyze how to monitor the integration of distributed training and rehearsal into ope contexts. Evaluate common measurement tools for assessing readiness in air-to-air, close air support training, rehearsal, and exercise events. Explore scenario sequenci continuous learning. Conduct in-depth analysis of the training related shortfalls of c computer generated forces. Explore hardware and software solutions allowing funct selected friendly/enemy interactions for extremely high fidelity training. Research a parameters for a network server for high-fidelity weapons models which allows real-processing of DMO interactions for more accurate weapons effects and engagement In FY 2009: Develop tools to permit AF planners and managers to integrate competintor readiness parameters and assessment in operational training, rehearsal, and exert alternative approaches for evaluating the individual, team, and team of team (coalitie impacts of collaborative, distributed spin-up training and rehearsal. Evaluate integrat development and management methods for continuous learning in DMO and explore methods for performance aiding and training in operational contexts. Identify functif for instructor operator station capabilities. Investigate and evaluate physics-based d models for DMO systems. Define improved rule sets to enhance training utility of c forces. Assess feasibility of enhanced threat avoidance and rehearsal training combia aerodynamic models, directed energy models, and validated visual special effects.	ional training for combat g integration. erational readiness air-to-ground, and ng methods for urrent DMO tional processing of and analyze - or near real-time s. ency-based methods cise. Identify on) performance ated instructional e task allocation onal requirements irected energy threat omputer generated					
(U)							
(U)	MAJOR THRUST: Explore performance improvement techniques to enhance aeros training in realistic mission training environments. Research provides enabling tech improving readiness across an assortment of AF career fields, from combat air force control personnel.	nologies for	1.720	3.431	3.384	3.619	
(U)	In FY 2006: Created a communication model through cognitive science principles a improve the training of AOC airmen. Established computational techniques to predidistribution of training opportunities influences the acquisition and long-term retention by verifying and validating predictive skill acquisition and decay models with DMO	ict how the on of complex skills					
Pro		Item No. 7 -5 of 28			Exhibit R-2a (I	PE 0602202F)	
Pro		35			Exhibit R-2a (I	<sup>2</sup> E 0602202F)	

	Exhibit R-2a, RDT&E Project Just	tification		DATE	DATE February 2007		
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602202F Human E Applied Research		IBER AND TITLE	LE		
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2007: Integrate the communication model with a synthetic communication ag assess training value. Verify and validate the knowledge and skill tracking prediction actual training data. Implement initial semi-automated parameter search capability of performance computing for moderator models.	n models with vith high	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Expand the depth of the communication models to support the full range grammar used in the AOC training environment. Conduct empirical study with skill acquisition/retention models. Extend automation functionality to include dynamic m refinement capability.	- -					
(U)	In FY 2009: Expand the breadth of the communication model to support end-to-end processing. Integrate knowledge and skill tracking prediction system with mission e competencies to predict training requirements for airmen and demonstrate ability to individualized training programs. Implement graphical user interface for performance prediction system.	ssential produce					
(U)							
(U)	CONGRESSIONAL ADD: Airman Performance Integration (AIRPRINT) (previou Performance Research Integration Tool (IMPRINT)).	sly titled Improved	2.432	1.993	0.000	0.000	
(U)	In FY 2006: Conducted Congressionally-directed effort for IMPRINT.						
(U)	In FY 2007: Conduct Congressionally-directed effort for AIRPRINT.						
(U)	In FY 2008: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U) (U)	CONGRESSIONAL ADD: Component Object Model (COM) Attitude Control Sys Simulation/Trainer.	tem	2.141	1.096	0.000	0.000	
(U)	In FY 2006: Conducted Congressionally-directed effort for COM Attitude Control S	System					
(U)	Simulation/Trainer. In FY 2007: Conduct Congressionally-directed effort for COM Attitude Control Systemulation/Trainer.	stem					
(U)	In FY 2008: Not Applicable.						
(U) (U)	In FY 2009: Not Applicable.						
(U)	CONGRESSIONAL ADD: C4ISR Fusion System.		0.973	1.593	0.000	0.000	
Pro		Item No. 7 -6 of 28			Exhibit R-2a (F	PE 0602202F)	
		36					

				MCLASSI				DATE			
	Exhibit	R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007	
BUDGET ACTIVITY 02 Applied Research				0602					JECT NUMBER AND TITLE 3 Warfighter Training		
<ul> <li>(U) <u>B. Accomplishments/Planned I</u></li> <li>(U) In FY 2006: Conducted Congress</li> <li>(U) In FY 2007: Conduct Congressi</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	ssionally-direct	ed effort for C		•		<u>FY 2</u>	<u>006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul><li>(U)</li><li>(U) Total Cost</li></ul>						16.9	992	20.247	13.024	13.850	
(U) <u>C. Other Program Funding Sur</u>	<u>mmary (\$ in M</u> <u>FY 2006</u> <u>Actual</u>	<mark>Iillions)</mark> <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate		<u>Cost to</u> Complete	I OTAL COST	
<ul><li>(U) Related Activities:</li><li>(U) PE 0602233N, Human Systems Technology.</li></ul>									<u></u>		
<ul> <li>(U) PE 0602716A, Human Factors Engineering Technology.</li> <li>(U) PE 0602785A, Personnel Performance and Training</li> </ul>											
<ul> <li>Technologies.</li> <li>(U) PE 0603231F, Crew Systems and Personnel Protection Technology.</li> </ul>											
<ul><li>(U) PE 0604227F, Distributed Mission Training (DMT).</li></ul>											
<ul> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>											
(U) <u><b>D. Acquisition Strategy</b></u> Not Applicable.											
				R-1 Line Item No	o. 7						

	Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on			DATE	February 2	2007
BUDGET ACTIVITY 02 Applied Research	plied Research 0602202F Human Effectiveness 7						ss 71	PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences		
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
7184 Decision Effectiveness & Biosciences	68.731	62.682	48.597	47.368	60.812	53.080	55.151	58.978	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
This project develops the technology response, and survivability in disperse improve logistical support for peaceti systems operators; it determines huma impact, vibration, and maneuvering a produces human-centered design crite information display, team communica evaluations of control interfaces, crew identify and minimize the risks and m cycle cost.	ed operational of me and combar an responses to cceleration, and eria, guidelines ations, and mod v station layout	environments. t operations. military uniq d it explores w , and design to leling and sim and functiona	By investiga This research ue stresses sur- yays to assess pols for develo- ulation for hu al integration,	ting the techn further defines ch as operation and manage h oping effective iman-centered and human in	ologies to enh s the physical ns in sustained uman operato e human-syste aerospace and formation pro	ance deploym and cognitive I and extreme r workload by m interfaces. I cyber operat cessing. It als	ent capabilitie parameters, c environments optimizing th It develops ar ions. It condu o develops bi	es this program apabilities, and including the ne human-mac nd assesses tec acts experiment otechnologies	n seeks to d limits of effects of nois hine interface. hnologies for its and and tools to	
<ul> <li>(U) <u>B. Accomplishments/Planned Prog</u></li> <li>(U) MAJOR THRUST: Develop interfaction collaboration in network-centric warf operational understanding and shared</li> </ul>	ce technologies fare environme	that enhance nts. These tec	hnologies wil	ll enable the co	ommon	<u>FY 20</u> 4.8		<u>Y 2007</u> 5.680	<u>FY 2008</u> 4.990	<u>FY 2009</u> 4.956
<ul> <li>(U) In FY 2006: Initiated development of on multilingual phoneme acoustic more forces. Completed development of h of a collaboration toolkit, both essent management command and control (I assessment package that enables real-</li> <li>(U) In FY 2007: Determine the risk and I laboratory speech recognizer/synthes development of a collaboration toolkit technologies, and formulate plans to program. Demonstrate the ability of human-machine collaboration during</li> </ul>	odels designed uman-machine ial for develop BMC2). Comp -time human-m benefit of addin izer, and advan it for BMC2. I demonstrate op the cognitive so	to enhance co interface style ing effective v bleted develop hachine collab- ng language, a lice speech pro Develop and e perational bene- tate assessment	llaboration be e guide and co varfighter inte ment of an op oration. .ccent, and do cessing techno valuate BMC2 efits in an adv	etween multina commenced devertaces for air berator cognitive main models i ology. Compl 2 decision sup anced technology	ntional velopment battle ve state nto the lete port ogy					
Project 7184				I Line Item No. 7 Page-8 of 28 <b>138</b>	7				Exhibit R-2a (P	E 0602202F)

	Exhibit R-2a, RDT&E Project Justification February 2007							
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Ef Applied Research	0602202F Human Effectiveness		IBER AND TITLE on Effectiveness & S			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2008: Begin to develop multinational speech translator technologies continue to advance technologies that support mobile, speech-based interfact for applying collaborative tools in BMC2 environments. Begin to develop non-airborne command and control missions. Expand the operator cognitive incorporate operator performance data, operator performance and situational tactical situation information for better decision support.	ces. Complete a style guide a collaboration toolkit for re state assessor to						
	In FY 2009: Explore the use of transparent multilingual collaboration tools teaming. Continue to develop multinational speech translation technologies. Determine the effects of collaboration technologies on performance efficient awareness, workload and decision making for tactical command and control automated human-machine interfaces to improve real-time human-machine predictive operator state models and assessment tools for dynamic workflow.	s for obscure languages. hcy, shared situation l. Begin to develop adaptive task sharing. Develop						
(U) (U)	MAJOR THRUST: Develop cognitive system interface technologies to act at all echelons of operations and to improve decision-making and predictive These technologies offer breakthrough potential for understanding and mod order to assure timely and effective decisions, while also providing context interfaces that support decision effectiveness.	e battlespace awareness. leling human behavior, in	3.439	4.655	3.977	4.350		
(U)	In FY 2006: Identified and developed software design patterns that enable re-use of human-computer interface elements in command and control ISR collaboration techniques that enable diverse users to share a common objec problem domain. Researched the cultural and ethnic bases of human decisi methods to represent knowledge about adversaries as a key technology in o effects-based operations.	systems. Began to develop t representation of the on-making. Developed						
(U)	-	e elements in command and thods to embed them into c bases of human decision						
(U)	In FY 2008: Continue advancement of software design patterns that enable	the standardization and						
Pro	ject 7184	R-1 Line Item No. 7 Page-9 of 28			Exhibit R-2a (I	PE 0602202F)		

	Exhibit R-2a, RDT&E Project Justification February 2007							
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602202F Human Ef Applied Research	0602202F Human Effectiveness			ess &		
re-use of human-com DoD software design to embed these techn a distributed net-cent decision making and differences for effect (U) In FY 2009: Expand patterns in graphical distributed net-centrit team self-synchronizz making and developi	contents of DoD software design patterns library. Begin user interface building tools. Continue to demonstrate co e environment. Investigate how collaboration techniques ation. Continue researching the cultural and ethnic bases ng human performance models that reflect cultural differ	a techniques and methods collaboration techniques in thnic bases of human at reflect cultural a embedding design ollaboration techniques in a c can enable distributed of human decision ences to enable	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	ons. Transition select models to advanced development p	brograms.						
<ul> <li>(U) MAJOR THRUST: 1 Joint Forces Comman the past, present, and during joint operation</li> <li>(U) In FY 2006: Develop information to be inc Developed methods t making" tools for dyn potential adversaries</li> </ul>	bed advanced visualization techniques that enable the und proported into the iconic or graphic portrayal scheme for o simulate enemy potential courses of action. Initiated d namic battlefields. Researched knowledge representation and complex systems of systems. Initiated development	mand staffs to interrelate and actions of adversaries certainty associated with command center display. evelopment of "sense a techniques to model of a set of integrated work	4.164	3.735	1.934	2.284		
	a commander's decision-making in a future environment g and Operations (APO).	of continuous						
associated with infor- center display. Conti- to simulate enemy po Conduct laboratory e Continue to develop	e developing advanced visualization techniques that enal nation to be incorporated into the iconic or graphic portr nue to develop, and begin to transition to advanced deve tential courses of action, beginning with simple models of xperiments to evaluate "sensemaking" tools and displays knowledge representation techniques to model potential a Continue to develop an integrated set of APO work aids	ayal scheme for command lopment, methods needed of adversary behavior. for dynamic battlefields. adversaries and complex						
Project 7184	R	-1 Line Item No. 7 Page-10 of 28			Exhibit R-2a (I			

	Exhibit R-2a, RDT&E Projec	ct Justification		DATE	DATE February 2007			
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Ef Applied Research	0602202F Human Effectiveness			ess &		
(U)	<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u> operational planning, persistent prediction, and focused execution even as n</b>	nilitary and broad national	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	security objectives are dynamically changing.	niques for command center						
	courses of action, including more complex adversary behavior. Evaluate re- experiments on "sensemaking" tools and displays for dynamic battlefields.	sults of the laboratory Identify gaps for further						
	research. Begin incorporating the extrapolated, select "sensemaking" result Refine the knowledge representation techniques to model potential adversar systems and begin integrating into displays. Initiate transition of integrated	ries and complex systems of						
	achieve persistent operational planning, persistent prediction, and focused e demonstration of the integration of the developed displays and technologies	xecution. Conduct initial						
(U)	In FY 2009: Analyze the results of the initial demonstration of the integrati technologies. Complete the transition of advanced uncertainty visualization	on of the displays and						
	center display. Continue transition of methods needed to simulate enemy p including more complex adversary behavior. Incorporate more extrapolated	potential courses of action,						
	displays. Refine the knowledge representation techniques to model potentia systems of systems and begin integrating into displays. Continue transition	al adversaries and complex						
	work aids to achieve persistent operational planning, persistent prediction, a evaluate the effect. Conduct follow-on demonstration of the integration of t technologies.	and focused execution and						
(U)								
(U)	MAJOR THRUST: Develop system control interface concepts enabling ful platform capabilities. Identify the best mix of intelligent methods and tradit		4.503	4.845	4.705	4.477		
	unambiguously direct the operator's attention, which is critical for net-centric real-time and wargaming simulations to quantify operational benefits from a concepts.	ic operations. Employ						
(U)	In FY 2006: Using virtual simulation, evaluated decision support interface operator supervision of multiple semi-autonomous unmanned systems. For							
	vehicles, evaluated first generation control-display concepts that reduce ope	erator task load and mitigate						
	channelized attention. Developed fusion algorithms that combine on-board with imagery. Explored the integration of computer-generated pictures with							
	ject 7184	R-1 Line Item No. 7 Page-11 of 28				PE 0602202F)		

	Exhibit R-2a, RDT&E Project	Justification		DATE	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human E Applied Research	ffectiveness		UMBER AND TITLE sion Effectiveness & es		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> autonomous approach and landing.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Demonstrate real-time assessment tools and advanced decision su including prediction capability, for maximizing single operator supervision of autonomous unmanned aerial vehicles (UAVs) within net-centric environment development of second generation control-display concepts that reduce operator channelized attention. Begin algorithm development to blend display imagery graphical representations of terrain and real-time data to conduct autonomous lo operations at night and during adverse weather.	multiple highly s. Begin design and or task load and mitigate with computer-generated					
(U)	In FY 2008: Evaluate single operator supervision of multiple autonomous UA context using real-time assessment tools and advanced decision support interfa simulated ground operations. Transition field test results of first generation co that reduce operator task loading and channelized attention into second generat workstations. Apply basic algorithms that blend display imagery with comput representations of terrain and real-time data during simulation and/or fight-test landing and ground operations.	ices during testing and ntrol-display concepts tion control-display er-generated graphical					
(U)	In FY 2009: Integrate real-time assessment tools into second generation contro- workstations to optimize operator task loading and avoid channelized attention operator workstations during field testing and flight demonstration to control m autonomous UAVs. Begin software design and development of common inter architectures of control-display concepts that allow minimal numbers of operator UAVs in urban environments and/or in large-scale, strategic military operation	n. Use second generation nultiple, highly face and software tors to control autonomous					
(U) (U)	MAJOR THRUST: Develop technologies associated with collecting and optir information for best assimilation by warfighters. Develop, evaluate, and organ enhancing input to the visual system through the fusion of multi-spectral senso processing, and solid-state display technologies in order to enhance real-time, systems. Devise human-centered command and control symbology and techni visual displays, permitting natural situation understanding of complex information	nizing visually displayed nize algorithms for ors, digital image day/night imaging ques for integration with tion rich environments.	5.117	4.385	4.723	4.570	
(U)	In FY 2006: Developed algorithms to electronically enhance vision when usin state imagers. Evaluated those algorithms using realistic simulations of warfig Developed methods to depict command and control and other complex types o	hter visual tasks. f information in intuitive,					
Pro	oject 7184	1 Line Item No. 7 Page-12 of 28			Exhibit R-2a (	PE 0602202F)	

PE NUMBER AND TITLE 0602202F Human Ef Applied Research y enhance vision when using command and control and other complex	fectiveness <u>FY 2006</u>		BER AND TITLE on Effectivent	ess & FY 2009
command and control and other complex	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	FY 2009
command and control and other complex				<u>1 1 2007</u>
valuate the methods using realistic				
ive ways to visualize and interact with Evaluate display symbologies and				
s of display algorithm sets that have been and interaction techniques to enhance interfaces. Test these methods against ctiveness. Begin to develop visualization				
n, and related technologies that mitigate cessing in the operational environment. In	3.915	4.361	3.958	3.794
ing. Explored the value of acoustic e acoustic detection of vectored thrust to improve collaboration in operational use of ultrasonic auditory projection can				
nologies and use of acoustic signal				
R-1 Line Item No. 7 Page-13 of 28			Exhibit R-2a (F	PE 0602202F)
	ratory-grade test bed usable to perform tive ways to visualize and interact with evaluate display symbologies and environments. s of display algorithm sets that have been and interaction techniques to enhance r interfaces. Test these methods against ctiveness. Begin to develop visualization ce understanding in command centers of ogies for human-to-human collaboration on, and related technologies that mitigate cessing in the operational environment. In with warfighter equipment and amplify uman-to-human communications through ing. Explored the value of acoustic e acoustic detection of vectored thrust to improve collaboration in operational use of ultrasonic auditory projection can mprove human-to-human communications hnologies and use of acoustic signal es. Begin to research methods to R-1 Line Item No. 7	ratory-grade test bed usable to perform tive ways to visualize and interact with Evaluate display symbologies and environments. s of display algorithm sets that have been and interaction techniques to enhance r interfaces. Test these methods against ctiveness. Begin to develop visualization ce understanding in command centers of ogies for human-to-human collaboration on, and related technologies that mitigate occessing in the operational environment. In with warfighter equipment and amplify uman-to-human communications through ing. Explored the value of acoustic e acoustic detection of vectored thrust to improve collaboration in operational use of ultrasonic auditory projection can nprove human-to-human communications hnologies and use of acoustic signal es. Begin to research methods to R-1 Line Item No. 7 Page-13 of 28	ratory-grade test bed usable to perform tive ways to visualize and interact with Evaluate display symbologies and e-environments. s of display algorithm sets that have been a and interaction techniques to enhance r interfaces. Test these methods against ctiveness. Begin to develop visualization ce understanding in command centers of ogies for human-to-human collaboration n, and related technologies that mitigate ccessing in the operational environment. In with warfighter equipment and amplify uman-to-human communications through ing. Explored the value of acoustic e acoustic detection of vectored thrust to improve collaboration in operational use of ultrasonic auditory projection can nprove human-to-human communications hnologies and use of acoustic signal es. Begin to research methods to R-1 Line Item No. 7 Page-13 of 28	ratory-grade test bed usable to perform tive ways to visualize and interact with Evaluate display symbologies and environments. s of display algorithm sets that have been n and interaction techniques to enhance r interfaces. Test these methods against ctiveness. Begin to develop visualization ce understanding in command centers of ogies for human-to-human collaboration 3.915 4.361 3.958 on, and related technologies that mitigate ccessing in the operational environment. In with warfighter equipment and amplify uman-to-human communications through ing. Explored the value of acoustic e acoustic detection of vectored thrust to improve collaboration in operational use of ultrasonic auditory projection can mprove human-to-human communications hnologies and use of acoustic signal es. Begin to research methods to R-1 Line Item No. 7 Page-13 of 28 Exhibit R-2a (F

Exhibit R-2a, RDT&E Project Jus	stification		DATE	DATE February 2007		
ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human Ef Applied Research	fectiveness		MBER AND TITLE ion Effectiveness & s		
<b>B. Accomplishments/Planned Program (\$ in Millions)</b> incorporate weather effects on noise propagation and ways to represent weather eff models. Continue to develop auditory information aiding technologies for remote of Explore how to improve audio symbology for streamlining command and control of 3-D audio symbology. Begin to explore the human processes that lead to commun	collaboration. perations including ication breakdown.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
In FY 2008: Explore the potential of acoustic aiding during urban operations to immachine-to-human communications by using acoustic signal processing to improve information gathering. Begin to research ways to adapt current noise models to end decision-making and acoustic detectability during offensive operations. Continue to information-aiding technologies for remote collaboration, by exploiting advances in theory for individuals. Continue to explore the individual and group processes that communication breakdown. Explore improved auditory sensing to create virtual at human interface to remote sensing.	e security forces' hance to develop auditory n communication lead to iditory reality for					
In FY 2009: Develop acoustic aiding for urban operations to improve machine-to- communications by using ultrasonic and laser technology advances to improve sect information gathering. Continue to research methods and develop models to predic detectability under dynamic conditions for improved offensive operations. Continu information-aiding technologies for remote collaboration by exploiting advances in theory for individuals. Continue to explore the individual and group processes that communication breakdown. Improve auditory sensing technology to create virtual human interface to remote sensing, emphasizing its application to security forces.	urity forces' ct acoustic le to develop auditory communication lead to					
MAJOR THRUST: Develop integrated human-centered Information Operations (I Surveillance, and Reconnaissance (ISR) technologies to provide quicker and more information, enhanced decision-making capabilities, more effective training proceed tools for IO/ISR operators' use in performing their respective missions.	intuitive access to	8.947	11.375	9.149	10.215	
In FY 2006: Conducted research to develop better visualization for spectral data eximprove predictive battlespace awareness capabilities. Developed next stage of protechnologies to specify, measure, and model key parameters.	-					
In FY 2007: Conduct research and implementation of models for IO and ISR. Dev human system interfaces for additional Measurement and Signatures Intelligence (I capabilities, specifically in the spectral area. Develop tools and models for assessing	MASINT)					
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	Exhibit R-2a, RDT&E Project Ju	ustification		Exhibit R-2a, RDT&E Project Justification February 2007								
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Ef Applied Research		BER AND TITLE								
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> influence operations. Complete development of proof-of-concept technologies to model key parameters. Research and develop counter-Improved Explosive Devic concepts/devices.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>						
(U)	In FY 2008: Validate conceptual human-system interfaces for additional MASIN Develop and validate tools and models for assessing the effectiveness of influence research and development of tools and capabilities for Influence Operations and of Operations. Continue development of tools and models for assessing the effective operations. Continue research and validation of speech-to-speech translation tool anticipate adversarial behavior, both individually and in groups. Continue counter	e operations. Continue counter-Influence eness of influence . Develop capability to										
(U)	In FY 2009: Continue development and validation of advanced IO/Influence Op and training techniques to enable increased offensive and defensive combat capal asymmetric adversarial threats. Validate and complete IO/Influence Operations I capabilities. Develop and validate prototype of advanced speech-to-speech trans- development of capability to anticipate adversarial behavior, both individually an application in the psychological operations domain. Continue counter-IED resea collaborative tools and training for ISR team applications with emphasis on distri	erations research tools bilities which counter nodels and simulation ation tool. Continue d in group, with rch. Develop										
(U) (U)	MAJOR THRUST: Develop human injury criteria and protective system technol sanctuary from injury and disability causing threats to military personnel. Resear technologies to ensure accommodation and safety of all airmen during military of ground patrols, crashes, emergency escape, extended missions, and parachute ope	ogies to provide ch will develop perations, such as flight,	5.455	5.721	4.487	4.125						
(U)	In FY 2006: Using available safety and medical databases, evaluated and began injury and physical health effects causes. Defined criteria functions to relate seat measurable parameters for use in seating requirements. Developed initial collabor system for analyzing environmental threats and developing immunity strategies. and interrelationships between equipment fit, workload, marginal anthropometry, capability.	addressing primary AF cushion comfort to rative information Investigated the effects										
(U)	In FY 2007: Develop injury criterion for multi-axial dynamic neck loading and s and demographics. Determine the effects and interrelationships between equipm marginal anthropometry, physical capability, cognitive capability, and increased pilot crew performance. Using risk-based analysis, identify primary musculoskel	ent fit, workload, equipment loads on										
	R-1 L											

	Exhibit R-2a, RDT&E Project	Justification		Exhibit R-2a, RDT&E Project Justification February 2007								
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Ef Applied Research	fectiveness	PROJECT NUM 7184 Decisio Biosciences								
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) and begin addressing equipment, procedure, or physical training improvements	-	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>						
(U)	mining and analysis tools for searching across biomechanics, safety, and medic In FY 2008: Conduct focused injury surveillance studies on specific career fiel identify those that have high rates of injury and disability. Based on these studie technologies to reduce musculoskeletal disabilities and injuries due to personal workstation designs. Develop procedures and training improvements to reduce due to injury, especially focused on battlefield airmen training. Expand initial to collaborative information system to coordinate DoD biomechanics data collectic capabilities.	ds and assignments to les, begin developing equipment and high training attrition piomechanics										
(U)	In FY 2009: Optimize equipment technologies, refine procedures, and improve address the most common AF job-related injuries and disabilities. Extend these only prevent injuries but also to optimize human performance. Develop workst maximize operator performance and minimize fatigue, based on interrelationshi fit, workload, anthropometry, physical capability, and cognitive capability. Use collaborative information technologies to collect and analyze biometric data for foe personnel identification in hostile environments.	e improvements to not ation design criteria to ips between equipment e the biomechanics										
(U) (U)	MAJOR THRUST: Quantify and model operator performance in stressful envi technologies to mitigate the effects of operational stressors on cognitive function effectiveness. Develop solutions to enhance human performance and ensure co- operations.	n, safety, and mission	1.562	1.540	2.004	0.538						
(U)	In FY 2006: Investigated asymmetric helmet loads in high-G environment and helmet aiming and pointing. Incorporated cognitive model into wargaming sce simulation-based acquisition.											
(U)	In FY 2007: Develop concepts to reduce effects of heavy flight helmets in the Complete validation and transition of high-G cognitive model for simulation-ba Explore biobehavioral technologies to augment cognition and enhance operator	ased acquisition.										
(U)	In FY 2008: Continue behavioral research to characterize human performance degradation during demanding military operations. Develop real-time biobehav monitoring technology to evaluate cognitive readiness and decision making in c applications, tactical operations, and mission rehearsal. Explore emerging cogr	and mitigate cognitive vioral performance command and control										
	ject 7184	Line Item No. 7			Exhibit R-2a (F							

	Exhibit R-2a, RDT&E Project Jus	tification		DATI	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research			ABER AND TITLE on Effectiven S	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	technologies and potential countermeasures. In FY 2009: Continue behavioral neuroscience research to characterize and mitigat degradation during demanding military operations. Refine real-time biobehavioral p monitoring technology and develop operational employment concepts. Continue to cognitive disruption technologies and potential countermeasures.	performance				
(U) (U)	MAJOR THRUST: Develop, demonstrate, and apply experimental models for pred compromises in human mission performance and create in-house and field methods of AF personnel from toxic hazards and exposures in Joint operational environment biological approaches, create predictive algorithms to describe functional cellular de engineering constructs for advancing detection and performance of AF systems. Im decision-making ability to properly balance mission and force protection requirement	to assure protection s. Using integrated ynamics and prove commander	0.816	2.062	1.779	1.560
(U)	In FY 2006: Developed procedures and computer simulation models to predict effect compound and nanomaterial exposure on Air Expeditionary Forces and improve the Force personnel in operational environments. Developed and demonstrated algorith function of cellular dynamics with the potential for improved logic and sensor effect systems.	cts of toxic protection of Air ms to describe the				
(U)	In FY 2007: Apply procedures and computer simulation models to predict effects of and nanomaterial exposure on Air Expeditionary Forces and improve the protection operational environments. Further develop and demonstrate algorithms to describe cellular dynamics with the potential for improved logic and sensor capability for Air	of AF personnel in the function of				
(U)	In FY 2008: Develop and apply procedures and computer simulation models to prevolume material, toxic compound, and nanomaterial exposure on Joint Service and Forces. Using computer modeling and integrated biological approaches to understa cellular dynamics and engineering, explore and create integrated new sensor and ma AF applications.	dict effects of large Air Expeditionary nd functional				
	In FY 2009: Further develop procedures and computer simulation models to predic compound and nanomaterial exposure on Joint Service and Air Expeditionary Force modeling and systems biology approaches to understand functional cellular dynamic continue to explore and create integrated new sensor and material constructs for AF	es. Using computer cs and engineering,				
(U)		tom No. 7				
Pro		e Item No. 7 -17 of 28			Exhibit R-2a (I	PE 0602202F)

BUDGET ACTIVITY         PE NUMBER AND TILE 0502 2022 Human Effectiveness Applied Research         PROJECT NUMBER AND TILE THE PENDERFERST           (1)         B. Accomplishmente/Planned Program (5 in Millions)         FY 2006         FY 2007         FY 2008         FY 2009         FY 2009         State Disciences           (1)         MAJOR THRUST: Develop biotechnologies to identify wargihter exposures to hazardous agents         4.881         5.844         4.098         3.467           before they result in illness or a reduction in mission performance, thus greatly improving force protection and the probability of mission success.         In FY 2006: Conducet genomic, proteomic, and metabolite studies to identify target-organ biomatkers in body fluids of the deployed airmen exposed to hazardous agents. Complete kidiney and assess fiver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.         In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Complete validation panel for selected kidney biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agent exposure. Complete validation panel for selected kidney biomarkers of degradation from hazardous agent exposure.         1.901         2.203         2.793         3.032           (1)         In FY 2009: Complet genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown ha		Exhibit R-2a, RDT&E Project Jus	tification		DATE February 2007			
<ul> <li>(L) MAJOR THRUST: Develop biotechnologies to identify warfighter exposures to hazardous agents before they result in illness or a reduction in mission performance, thus gready improving force protection and the probability of mission success.</li> <li>(L) In FY 2006: Conducted genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Assessed kidney and liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents. Assessed kidney and liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents. Assessed kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents. Assessed kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents. Oraplete kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.</li> <li>(L) In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agent exposure. Complete validation panel for selected kidney biomarkers of Apersonnel.</li> <li>(L) In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers of hazardous agent exposure. Extend program to investigate connect: tissue, lang, and brain biomarkers of degradation from hazardous agent exposure in AF personnel.</li> <li>(L) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to support large-seale advanced technology development programs. These technologies will lead to more efficient ultization of logistics resources for Air Expectionary Force operations.</li> <li>(L) In FY 2006: Complete examination</li></ul>			0602202F Human	Effectiveness	7184 Decisi	on Effectiven		
<ul> <li>(U) In FY 2006: Conducted genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Assessed kidney and liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.</li> <li>(U) In FY 2007: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Complete kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents. Complete kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.</li> <li>(U) In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Complete validation path for selected kidney biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agent exposure. Complete validation path for selective divides biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agent exposure. The personnel.</li> <li>(U) In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agent exposure in AF personnel.</li> <li>(U) In FY 2009: Complete genomic, proteomic, and metabolite studies to investigate connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF personnel.</li> <li>(U) In FY 2007: Continue to releasing the exposure of the effects of thure logistics readvanced technology development programs. These technologies will lead to more efficitent utilization of logistics res</li></ul>	` ´	MAJOR THRUST: Develop biotechnologies to identify warfighter exposures to have before they result in illness or a reduction in mission performance, thus greatly impr	•					
<ul> <li>(U) In FY 2007: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Complete kidney and assess liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.</li> <li>(U) In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Complete validation panel for selected kidney biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agent exposure. Iteration of the effects of unknown hazardous agent exposure in deployed airmen. Extend program to investigate connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF personnel.</li> <li>(U) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to 1.901 2.203 2.793 3.032 support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of new techniques to identify both functional and system requirements. Investigate and applied new information presentation techniques for future logistics reading reserves prod "capabilities which will promote effects-based logistics and maintenance operations in support of flying missions.</li> <li>(U) In FY 2006: Completed examination of new techniques to identify both functional and system requirements. Investigate and applied new information presentation techniques for future logistics reserves respond "sense-respond" capabilities which will promote effects-based logistics through a common operating picture. Developed methods of quantifying levels of success of logistics and maintenance operations in support of flying missions.</li> <li>(U) In FY 2007: Continue to investigate and apply new techniques for future logistics and maintenance operations in</li></ul>	(U)	In FY 2006: Conducted genomic, proteomic, and metabolite studies to identify targ in body fluids of the deployed airmen exposed to hazardous agents. Assessed kidne response biomarker patterns for early detection of the effects of unknown hazardous	y and liver organ					
<ul> <li>(U) In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to identify target-organ biomarkers and their assessment methods for hazardous agent exposure. Complete validation panel for selected kidney biomarkers and down-select liver organ response biomarker patterns for early detection of the effects of unknown hazardous agents on AF personnel.</li> <li>(U) In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers of hazardous agent exposure in deployed airmen. Extend program to investigate connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF personnel.</li> <li>(U) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to 1.901 2.203 2.793 3.032 support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force operations.</li> <li>(U) In FY 2006: Completed examination of new techniques to identify both functional and system requirements. Investigated and applied new information techniques for future logistics and maintenance software tools. Defined "sense-respond" capabilities which will promote effects-based logistics rand apply new techniques for future logistics and maintenance technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics and maintenance technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics using a net-centric environment.</li> </ul>	(U)	In FY 2007: Continue to conduct genomic, proteomic, and metabolite studies to ide biomarkers in body fluids of the deployed airmen exposed to hazardous agents. Cor assess liver organ response biomarker patterns for early detection of the effects of un	nplete kidney and					
<ul> <li>(U) In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and validate kidney and liver biomarkers of hazardous agent exposure in deployed airmen. Extend program to investigate connective tissue, lung, and brain biomarkers of degradation from hazardous agent exposure in AF personnel.</li> <li>(U)</li> <li>(U) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to 1.901 2.203 2.793 3.032 support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force operations.</li> <li>(U) In FY 2006: Completed examination of new techniques to identify both functional and system requirements. Investigated and applied new information presentation techniques for future logistics and maintenance software tools. Defined "sense-respond" capabilities which will promote effects-based logistics and maintenance technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics and maintenance operations in support of flying missions.</li> <li>(U) In FY 2007: Continue to investigate and apply new techniques for future logistics and maintenance technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics using a net-centric environment.</li> </ul>	(U)	In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies to ide biomarkers and their assessment methods for hazardous agent exposure. Complete selected kidney biomarkers and down-select liver organ response biomarker patterns	validation panel for					
<ul> <li>(U) MAJOR THRUST: Develop logistics readiness technology options and perform feasibility studies to 1.901 2.203 2.793 3.032 support large-scale advanced technology development programs. These technologies will lead to more efficient utilization of logistics resources for Air Expeditionary Force operations.</li> <li>(U) In FY 2006: Completed examination of new techniques to identify both functional and system requirements. Investigated and applied new information presentation techniques for future logistics and maintenance software tools. Defined "sense-respond" capabilities which will promote effects-based logistics and maintenance operations in support of flying missions.</li> <li>(U) In FY 2007: Continue to investigate and apply new techniques for future logistics and maintenance technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics using a net-centric environment.</li> <li>R-1 Line Item No. 7</li> </ul>	(U)	In FY 2009: Complete genomic, proteomic, and metabolite studies to identify and v liver biomarkers of hazardous agent exposure in deployed airmen. Extend program connective tissue, lung, and brain biomarkers of degradation from hazardous agent ex-	to investigate					
<ul> <li>(U) In FY 2006: Completed examination of new techniques to identify both functional and system requirements. Investigated and applied new information presentation techniques for future logistics and maintenance software tools. Defined "sense-respond" capabilities which will promote effects-based logistics through a common operating picture. Developed methods of quantifying levels of success of logistics and maintenance operations in support of flying missions.</li> <li>(U) In FY 2007: Continue to investigate and apply new techniques for future logistics and maintenance technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics using a net-centric environment.</li> <li>R-1 Line Item No. 7</li> </ul>	• •	support large-scale advanced technology development programs. These technologie	-	1.901	2.203	2.793	3.032	
technical data presentation and for task/job aiding and training. Complete work on defining sense-respond capabilities which will promote effects-based logistics using a net-centric environment. R-1 Line Item No. 7	(U)	In FY 2006: Completed examination of new techniques to identify both functional a requirements. Investigated and applied new information presentation techniques for maintenance software tools. Defined "sense-respond" capabilities which will promote logistics through a common operating picture. Developed methods of quantifying least the sense-responder of the sense	future logistics and ote effects-based					
	(U)	technical data presentation and for task/job aiding and training. Complete work on o	lefining					
148	Pro	ject 7184 Page-	18 of 28			Exhibit R-2a (	PE 0602202F)	

	Exhibit R-2a, RDT&E Project Ju	DATE	DATE February 2007				
	GET ACTIVITY Applied Research	PE NUMBER AND TITL 0602202F Human Applied Research	Effectiveness		NUMBER AND TITLE cision Effectiveness & ces		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	Identify technology gaps to meet previously defined emergency response logistics	-					
(U)	0	<b>U</b>					
	virtual reality, and versatile media formats in packaging and delivering job/task ai						
	solutions for maintenance work. Investigate integration mechanisms for these hur						
	technologies with on-board diagnostic/health monitoring technologies to promote	more accurate system					
(III)	repair processes at the point of maintenance.						
(U)	In FY 2009: Further explore and apply integrated, multifunction job aiding conce controlled field tests. Investigate the usefulness of collaboration support for troub						
	complex field repair problems. Explore the hardware, software, and packaging iss						
	aid and on-the-job training devices for maintenance work.	sues for combined job					
(U)	and and on-the-job training devices for manicipance work.						
(U)	CONGRESSIONAL ADD: Special Operations Target Acquisition and Control S	uite (SO-TACS).	1.362	0.000	0.000	0.000	
(U)	In FY 2006: Conducted Congressionally-directed effort for SO-TACS.		11002	0.000	0.000	0.000	
(U)	In FY 2007: Not Applicable.						
(U)	In FY 2008: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U)							
(U)	CONGRESSIONAL ADD: Bacterial Ghost Vaccine for Influenza Virus.		0.973	0.000	0.000	0.000	
(U)	In FY 2006: Conducted Congressionally-directed effort for Bacterial Ghost Vacc	ine for Influenza					
	Virus.						
(U)	In FY 2008: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U)	CONCREGGIONAL ADD. EL. 'IL D'. L		0.072	0.000	0.000	0.000	
(U) (U)	CONGRESSIONAL ADD: Flexible Display and Integrated Communication Dev In FY 2006: Conducted Congressionally-directed effort for Flexible Display and		0.973	0.000	0.000	0.000	
(0)	Communication Device for the BAO.	Integrateu					
л	In FY 2007: Not Applicable.						
(U)	In FY 2008: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U)	11						
Pro		ne Item No. 7 ge-19 of 28			Exhibit R-2a (F	PE (16(122(12E)	
		149				L 0002202P)	

Exhibit R-2a, RI	DATE	February	2007		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human E Applied Research			IMBER AND TITLE sion Effectiveness &	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) CONGRESSIONAL ADD: Carbon Nanostructured Materi		4.866	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for	Carbon Nanostructured Material for Fluid				
Purification.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Fused Carbon Nanotube Mater		2.432	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Derification	Fused Carbon Nanotube Material for Fluid				
Purification. (U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) (U)					
(U) CONGRESSIONAL ADD: Rapid ID and Treatment for Ai	r Force Medical Service	0.973	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for		0.775	0.000	0.000	0.000
Medical Service.					
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Warfighter Pocket XP Project.		4.282	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for	Warfighter Pocket XP Project.				
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Networked Warfighter Decisio		1.362	0.996	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for	• • • • • • • • • • • • • • • • • • • •				
(U) In FY 2007: Conduct Congressionally-directed effort for N	etworked Warfighter Decision Support.				
(U) In FY 2008: Not Applicable.					
	R-1 Line Item No. 7				
Project 7184	Page-20 of 28 150			Exhibit R-2a (	PE 0602202F)

	Exhibit R-2a, RDT&E Project Just	DATE	DATE February 2007				
-	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Eff Applied Research	ectiveness		IBER AND TITLE on Effectiven S		
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Not Applicable.						
(U)	CONCREGGIONAL ADD. D'. M. I'. I DNA D.		0.072	0.007	0.000	0.000	
(U)	CONGRESSIONAL ADD: Bio Medical DNA Program. In FY 2006: Conducted Congressionally-directed effort for Bio Medical DNA Prog	rom	0.973	0.996	0.000	0.000	
(U) (U)	In FY 2000: Conducted Congressionally-directed effort for Bio Medical DNA Progra In FY 2007: Conduct Congressionally-directed effort for Bio Medical DNA Program						
(U)	In FY 2007. Conduct Congressionary-uncered error for Bio Medical DIVA Program In FY 2008: Not Applicable.	11.					
(U)	In FY 2009: Not Applicable.						
(U)	III I 2009. Not Applicable.						
(U)	CONGRESSIONAL ADD: Eyewear Display for Battlefield Operations.		0.973	0.996	0.000	0.000	
(U)	In FY 2006: Conducted Congressionally-directed effort for Eyewear Display for Ba	ttlefield Operations.	01770	0.770	0.000	0.000	
(U)	In FY 2007: Conduct Congressionally-directed effort for Eyewear Display for Battle	-					
(U)	In FY 2008: Not Applicable.	· · · · · · ·					
(U)	In FY 2009: Not Applicable.						
(U)							
(U)	CONGRESSIONAL ADD: Battlefield Automatic Life Status Monitor.		0.000	1.296	0.000	0.000	
(U)	In FY 2006: Not Applicable.						
(U)	In FY 2007: Conduct Congressionally-directed effort for Battlefield Automatic Life	Status Monitor.					
(U)	In FY 2008: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U)							
(U)	CONGRESSIONAL ADD: Miniature Tri-Axial Accelerometer.		0.000	0.996	0.000	0.000	
(U)	In FY 2006: Not Applicable.						
(U)	In FY 2007: Conduct Congressionally-directed effort for Miniature Tri-Axial Accel	erometer.					
(U)	In FY 2008: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U)							
(U)	CONGRESSIONAL ADD: Unmasking Deception and Denial.		0.000	0.996	0.000	0.000	
	In FY 2006: Not Applicable.	Duri 1					
	In FY 2007: Conduct Congressionally-directed effort for Unmasking Deception and	Denial.					
	In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
$(\mathbf{U})$	III F I 2009. Not Applicable.						
Dui		Item No. 7					
Pro		21 of 28 51			Exhibit R-2a (I	~E 0602202F)	

	Exhibi	t R-2a, RD	C&E Projec	ct Justifica	tion			DATE	February	2007
BUDGET ACTIVITY 12 Applied Research	060	0602202F Human Effectiveness 718				OJECT NUMBER AND TITLE 84 Decision Effectiveness & osciences				
U) <u>B. Accomplishments/Planned</u>	Program (\$ in	Millions)				<u>FY 20</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
U) U) Total Cost						68.7	731	62.682	48.597	47.368
<ul> <li>(U) C. Other Program Funding Su</li> <li>(U) Related Activities:</li> <li>(U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0602702F, Command, Control, and Communications.</li> <li>(U) PE 0603205F, Flight Vehicle Technology.</li> <li>(U) PE 0603231F, Crew Systems and Personnel Protection Technology.</li> <li>(U) PE 0603245F, Flight Vehicle Technology Integration.</li> <li>(U) PE 0604706F, Life Support Systems.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>	<u>mmary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<u>Aillions)</u> <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimat		Cost to Complet	- e Total Cos
Project 7184				R-1 Line Item No Page-22 of 28 152					Exhibit R-2a (	PE 0602202

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
	GET ACTIVITY Applied Research				06022	IBER AND TITL 02F Human d Research	Effectivenes	SS	PROJECT NUME 7757 Bioeffeo		ection
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012		Cost to	Total
7757	7 Bioeffects and Protection	Actual	Estimate	Estimate 18.235	Estimate 18.159	Estimate 19.372	Estimate 18.260	Estimate 18.2		Complete	TBD
113	Quantity of RDT&E Articles	25.646	26.245 0	18.255	18.139	19.372	18.200	18.2	59 18.68 <sup>°</sup>		
(U)	A. Mission Description and Budget	Item Justifics			· · · ·				· .		
	The project assesses the bioeffects of a provides tailored/agile human perform systems through technology developm safety, risk assessment, mission plann	nance optimization optimizat	tion technolog iorate/counter easures, person	gies to confron /exploit the bi	nt asymmetric iological effect	threats. The part of operation	project enables al stressors an esearch, techn	s the safe o nd other thr ology deve	perational use of eats. It address elopment, and v	of AF aerospace es areas such a	e IS
(U)	B. Accomplishments/Planned Progr						<u>FY 20</u>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	MAJOR THRUST: Conduct laborate	• •				-	5.6	48	6.779	6.354	6.419
(U) (U)	technologies to improve combat vision, including laser eye protection. Completed bioeffects studies and submitted recommendations for revisions to national and international safety standards in the near infrared based on laboratory data and validated models. Explored the use of biotechnology as an adjunct to human protection from certain laser exposures.										
(U)	In FY 2008: Integrate dynamic bi-dir diagnostic tools of laser eye damage f laser damage threshold database for n safety standards. Evaluate impact of	for collateral h	azard assessme engths to valid	ents of typical ate DoD, nati	l laser systems onal, and inter	. Expand national					
(U)	In FY 2009: Perform field and labor bi-directional reflectivity distribution assessment tool. Integrate collateral h performing high energy laser system weapon systems to predict, evaluate, a	atory experime calculations for nazard assessme demonstration	ents to verify a or use as high nent software r s. Initiate expo	and validate or energy laser c nodel into air eriments for f	ptical physics collateral hazar borne laser pla	model of d tform					
Proj	ect 7757				Line Item No. 7 Page-23 of 28	,				Exhibit R-2a (F	PE 0602202F)
					153						

	Exhibit R-2a, RDT&E Project Ju	DAT	DATE February 2007				
	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human E Applied Research			MBER AND TITLE fects and Protection		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
1	MAJOR THRUST: Conduct electromagnetic (EM) field bioeffects laboratory expresearch to enable the safe exploitation of directed energy technologies for communidentification, and weapons development while identifying countermeasures to EM	inication, target	5.265	6.570	6.089	5.739	
(U) ] (U) ](	In FY 2006: Evaluated the bioeffects of emerging directed energy weapons to ass effectiveness. Extended laboratory and field assessment techniques into the terahe new modeling tool to assess potential risks of millimeter waves. Refined modelin, to evaluate the human health, behavior, and performance impacts of high frequenc Evaluated effects of high power and high peak power EM systems using biotechno research to support scientifically-based human exposure standards.	ess safety and ertz range. Developed g and simulation tools y EM systems.					
(U) ] 9 9 9 9	In FY 2007: Further refine methods to evaluate the bioeffects of directed energy of safety and effectiveness assessments of emerging directed energy weapons. Contil laboratory and field assessment techniques into the terahertz range. Continue to evaluate the human health, behavior, and performance impact of systems. Continue to evaluate human health in response to high power and high p systems using biotechnology. Continue to conduct research to support scientifical	nue to extend nhance modeling and of high frequency EM eak power EM					
(U) ] t	exposure standards. In FY 2008: Explore tissue interactions from terahertz frequencies to evaluate saft tissue vulnerabilities. Improve EM tissue models to include terahertz and high por Continue research to support fielding and effectiveness of radio frequency (RF) di systems.	wer EM effects.					
(U) ] 1 1	In FY 2009: Conduct experiments to refine and eliminate gaps in RF exposure sta microwave, ultra-wide band, and high peak power RF systems. Integrate and imp bioeffects, and target effects computer models based on RF studies in microwave, peak power, and terahertz sources. Investigate RF bioeffects as a foundation for fi	rove human behavior, ultra-wide band, high					
(U)		Ī					
(U) 1 i	MAJOR THRUST: Develop biotechnologies to accurately and affordably support identification, neutralization, and assessment of threat agents. Perform counterpro- enable air operations to continue in the most efficient manner.		3.320	5.624	4.032	3.980	
	In FY 2006: Developed technologies to identify the production source of threat ag methods to assess the viability and activity of threat agents and continued counterp	-					
Proje		ne Item No. 7 je-24 of 28			Exhibit R-2a (	PE 0602202F)	

	Exhibit R-2a, RDT&E Project Jus	stification		DATE	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Effect Applied Research	ctiveness		NUMBER AND TITLE effects and Protection		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> to predict and minimize collateral damage.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Continue to develop technologies to identify the production source of Continue to develop and validate methods to assess the viability of threat agents affic countermeasures have been employed. Refine counterproliferation research to bett minimize collateral damage.	ter active					
(U)	In FY 2008: Continue to develop and validate methods to assess the viability and a agents after active countermeasures have been employed. Begin to develop techno the AF to locate biological warfare agents behind walls and inside of containers. C semiconductor material interactions with directed energy to enhance agent neutrality	logies that will enable haracterize organic					
(U)	In FY 2009: Refine viability assessment technologies and develop models that pre distribution patterns to minimize collateral damage from counterforce weapon deto develop advanced biological taggant technologies that will locate biological warfar and in containers. Investigate counterproliferation technologies capable of effective genetically modified biological threat agents.	dict plume nations. Continue to e agents behind walls					
(U) (U)	MAJOR THRUST: Develop novel technology solutions integrating behavioral psy metabolomic research, nutritional strategies, and personal protective technologies t performance optimization in multiple stressor environments. Results will optimize execution through increased human effectiveness, reduced attrition/lost training day post-mission recovery.	o enable human operational	1.366	1.630	1.760	2.021	
(U)	In FY 2006: Refined and tested fatigue model to expand performance predictions is space applications. Identified and assessed novel fatigue countermeasures and asses mechanisms to improve human performance in specific operational aerospace environments paraleged and demonstrated modeling of fatigue interventions.	ociated delivery					
(U)	Developed and demonstrated modeling of fatigue interventions. In FY 2007: Investigate individual differences in human performance variability a performance optimizing interventions. Extend individual performance research to workload distribution, task novelty, and experience on collaborative team performa demanding environment. Develop methodologies to tailor behavioral and physiolo achieve flexible task-based human performance capabilities.	quantify effects of ance in a cognitively					
(U)	In FY 2008: Continue to develop methodologies to tailor behavioral and physiolog integrate revolutionary concepts in metabolomics/human performance technologies						
Pro	ject 7757 Page	e Item No. 7 e-25 of 28 155			Exhibit R-2a (	PE 0602202F)	

	Exhibit R-2a, RDT&E Project Jus	DATE	DATE February 2007			
-	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human E Applied Research			JMBER AND TITLE ffects and Protection	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> training/operations. Continue research to quantify effects of workload distribution, experience on team performance in a cognitively demanding environment.	task novelty, and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	In FY 2009: Continue development and assess benefit of tailored/agile human performing optimization regimens to confront asymmetric threats. Expand biobehavioral performance vulnerability.					
(U) (U)	MAJOR THRUST: Develop technologies and procedures to counter physiological altitude flight, improve pilot performance under high, rapid-onset gravitational for oxygen. Research will enhance airman safety during global attack, global mobility operations missions. Note: Effort terminates in FY 2007 due to higher AF priorities	es, and deliver , and special es.	0.414	0.362	0.000	0.000
	In FY 2006: Evaluated advanced materials and innovative design concepts to redu burden of aircrew protective equipment. Completed Altitude Decompression Sickr model and transitioned mission planning risk assessment tool to ACC and AFSOC. performance characteristics of oxygen systems technologies for multiple special op In FY 2007: Evaluate ability of candidate integrated aircrew ensemble technology	ness (DCS) math Quantified erations scenarios.				
	address identified life support equipment deficiencies. Continue assessment of oxy systems technology effectiveness in a chemical environment. In FY 2008: Not Applicable.	-				
(U) (U)	In FY 2009: Not Applicable.					
(U) (U) (U) (U)	CONGRESSIONAL ADD: Genetics of Sleep Deprivation and Fatigue. In FY 2006: Conducted Congressionally-directed effort for Genetics of Sleep Dep. In FY 2007: Not Applicable. In FY 2008: Not Applicable.	rivation and Fatigue.	0.973	0.000	0.000	0.000
(U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Nanoparticles Directed by DNA Capture Elements for	the Detection and	1.264	0.000	0.000	0.000
(U)	Neutralization of Bioterrorist Agents. In FY 2006: Conducted Congressionally-directed effort for Nanoparticles Directed Elements for the Detection and Neutralization of Bioterrorist Agents.					
(U)	In FY 2007: Not Applicable. R-1 Lin	e Item No. 7				
Pro	ject 7757 Page	-26 of 28 156			Exhibit R-2a (F	PE 0602202F)

	Exhibit	R-2a, RD	F&E Projec	ct Justifica	tion			DATE	February	2007
BUDGET ACTIVITY 02 Applied Research				0602	UMBER AND TI 2202F Humai lied Researc	n Effectivene		ROJECT NUMB		ection
(U) <u>B. Accomplishments/Planned P</u>	rogram (\$ in	<u>Millions)</u>				<u>FY 2</u>	006	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2008: Not Applicable.										
(U) In FY 2009: Not Applicable.										
<ul><li>(U)</li><li>(U) CONGRESSIONAL ADD: Solid</li></ul>	l Electrolyte (	www.an Sonara	tor(SEOS)			4	672	4.284	0.000	0.000
(U) In FY 2006: Conducted Congress	•		· ,			4.	072	4.204	0.000	0.000
(U) In FY 2007: Conduct Congression	•									
(U) In FY 2008: Not Applicable.	5									
(U) In FY 2009: Not Applicable.										
(U)										
(U) CONGRESSIONAL ADD: Wart	-		-			2.	724	0.996	0.000	0.000
(U) In FY 2006: Conducted Congress	sionally-direct	ed effort for V	Varfighter Sust	ainability: Ma	ximizing					
Human Performance. (U) In FY 2007: Conduct Congression	nally_directed	effort for Wa	rfighter Sustair	aability: Maxii	mizina					
Human Performance.	many-unceted		ingilier Sustan	naonity. Maxin	mzing					
(U) In FY 2008: Not Applicable.										
(U) In FY 2009: Not Applicable.										
(U)										
(U) Total Cost						25.	646	26.245	18.235	18.159
(U) <u>C. Other Program Funding Sun</u>	<u>nmary (\$ in N</u>	<u>fillions)</u>								
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	Estimate	<u>Estimate</u>	Estimate	<u>Complete</u>	
(U) Related Activities:										
(U) PE 0602720A, Environmental										
Quality Technology. (U) PE 0603231F, Crew Systems										
and Personnel Protection										
Technology.										
(U) PE 0604617F, Agile Combat										
Support.										
(U) PE 0604706F, Life Support										
Systems.										
Project 7757				R-1 Line Item No Page-27 of 28					Exhibit R-2a (F	PE 0602202E)
				157	,					

Exhibit R-2a, RDT&E Pi	roject Justification	DATE February 2007
DGET ACTIVITY 2 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	T NUMBER AND TITLE
<b>D</b> <u><b>C. Other Program Funding Summary (\$ in Millions)</b></u>		
J) This project has been		
coordinated through the		
Reliance 21 process to harmonize efforts and		
eliminate duplication.		
) <u>D. Acquisition Strategy</u>		
Not Applicable.		
FF		
	R-1 Line Item No. 7	
roject 7757	Page-28 of 28	Exhibit R-2a (PE 0602202
	158	

#### PE NUMBER: 0602203F PE TITLE: Aerospace Propulsion

	Ex	DATE	DATE February 2007								
	T ACTIVITY plied Research				-	IBER AND TITL D <b>3F Aerospa</b>	<sub>E</sub> ace Propulsi	on			
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ III WIIIIolis)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	153.760	218.657	179.161	217.394	222.201	184.034	175.557	179.428	Continuing	TBD
3012	Advanced Propulsion Technology	19.272	29.825	21.984	21.639	23.203	23.141	22.936	23.461	Continuing	TBD
3048	Fuels and Lubrication	20.723	24.599	17.349	26.088	26.678	19.067	17.954	18.301	Continuing	TBD
3066	Turbine Engine Technology	33.107	42.568	51.506	83.546	76.501	46.558	40.753	41.676	Continuing	TBD
3145	Aerospace Power Technology	45.414	44.595	30.784	31.125	35.072	34.205	33.314	34.066	Continuing	TBD
33SP	Space Rocket Component Tech	0.000	58.085	46.819	45.915	48.989	49.192	48.478	49.494	0.000	0.000
4847	Rocket Propulsion Technology	35.244	18.985	10.719	9.081	11.758	11.871	12.122	12.430	Continuing	TBD

Note: In FY 2007, Project 33SP, Space Rocket Component Technology was transferred from PE 0602500F, Multi-Disciplinary Space Technology, Project 5026, Rocket Propulsion Component Technology, and Project 5027, High Speed Airbreathing Propulsion Technology, in order to more effectively manage and provide oversight of the efforts. In FY 2007, Project 3012, Advanced Propulsion Technology, combined efforts with a thrust from Project 33SP, Space Rocket Component Technology, in order to more effectively manage cooperative Combined Cycle Engine (CCE) developments. Funds for the FY 2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of \$3.0 million were moved to PE 0601102F, Defense Research Sciences, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY2006 Congressionally-directed Lightweight Photovoltaic Electricity and Hydrogen for Portable, On-Demand Power for Defense Applications in the amount of \$1.0 million were moved to PE 0602601F, Space Technology, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY 2007 Congressionally-directed High Energy Laser for Detection Inspection and Non-Destructive Testing in the amount of \$2.7 million are in the process of being moved to the Defense Advanced Research Projects Agency, from PE 062203F, Aerospace Propulsion, for execution. The funding in this PE has been increased to provide emphasis on component development in support of adaptive cycle technologies, improved fuel efficiency, and highly efficient embedded turbine engines.

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

This program develops propulsion and power technologies to achieve enabling and revolutionary aerospace technology capabilities. The program has six projects, each focusing on a technology area critical to the Air Force. The Advanced Propulsion Technology develops high-speed airbreathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies to enable revolutionary propulsion capability for the Air Force. The Fuels and Lubrication project evaluates fuels, lubricants, and combustion concepts and technologies for new and existing engines and directly supports the Versatile Affordable Advanced Turbine Engine (VAATE) program. The Turbine Engine Technology project develops enabling capabilities to enhance performance and affordability of existing weapon systems to include efforts that are part of the VAATE program. The Aerospace Power Technology project develops electrical power and thermal management technologies for ground, air, and space military applications that are part of the High Power Aircraft (HiPAC) program. The Space Rocket Component Technology project develops advances in rocket propulsion technologies for space access, space maneuver, and ballistic missiles. The Rocket Propulsion Technology project develops advances in rocket technologies for the sustainment of strategic systems and tactical rockets to include efforts that are part of the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) and Technology for the Sustainment Systems (TSSS) programs. Finally, the adaptive cycle technologies project develops component technologies for an adaptive cycle engine architecture to provide optimized performance/fuel efficiency for widely varying mission needs. Note: In FY 2007, Congress added \$1.0 million for Advanced High Speed Propulsion Development; \$3.9 million for X-51 Robust Scramjet Flight Research; \$2.7 million for

Exhibit R-2 (PE 0602203F

	Exhibit R-2, RDT&E Bu	dget Item Justification		DATE Februa	ry 2007
	DGET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Prop	oulsion		•
	High Energy Laser for Detection Inspection and Non-Destructive Tor million for Hybrid Bearings; \$2.0 million for Research Institute for Aircraft; \$1.8 million for Active Combustion Control Systems for M Affordable Advanced Turbine Engine (VAATE) Initiative; \$1.4 mil TMC FLADE Technology Demonstration; \$1.3 million for Advance Lightweight Power Supply; \$2.5 million for Chemical Hydride Pow \$1.0 million for Integrated Electric Starter/Generator; \$5.2 million for Thermal Management; \$1.0 million for Military Purpose Electrolyte million for Advanced Vehicle and Propulsion Center; \$3.6 million for Program (ETIP); \$1.6 million for Methane Second Stage Rocket En Lab Equipment Upgrade; and \$1.0 million for Solid Boost Propulsio Applied Research, since it develops and determines the technical fea	Environmental Studies (TRIES); \$3.9 million for filitary Aircraft; \$1.0 million for Advanced Affor lion for the Intelligent Engine Technology Devel ed Energy Technology for Munititions - Dominat er System; \$1.1 million for High Flux ESC Syste for Manufacturing of High Energy Superior Lithiu e Supported Fuel Cells; \$1.4 million for Advanced for Center for Solar Electricity and Hydrogen; \$2. gine; \$1.7 million for Advanced Vortex Hybrid F on Technology for the Sustainment of Strategic S	Active Combustion ( rdability Assurance To opment for UAVs; \$1 or Program; \$1.0 mill or with TES for Milit or Battery Technolog d Liquid Rocket Boos 8 million for Enginee Propulsion System; \$1 ystems. This program	Control System for M ools for the Versatile 1 million for VAAT lion for the Affordabl ary High Energy Lass gy; \$1.3 million for M ster Technology; \$3.2 rring Tool Improveme .0 million for Aerosp n is in Budget Activity	illitary E e er; IEPS ent ace
(U)	<b><u>B. Program Change Summary (\$ in Millions)</u></b>		·	-	
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	6	155.673	170.885	159.359	167.671
(U)	8	153.760	218.657	179.161	217.394
(U)	5	-1.913			
(U)	Congressional Program Reductions Congressional Rescissions	-0.018	-0.828		
	Congressional Increases	-0.018	42.600		
	Reprogrammings	0.656	6.000		
	SBIR/STTR Transfer	-2.551	0.000		
(U)		2.501			
(-)	Not Applicable.				
	C. Performance Metrics (U) Under Development.				
		R-1 Line Item No. 8 Page-2 of 44		Exhibit R-	2 (PE 0602203E)

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on					2007
		February 2007           February 2007           February 2007           Project NUMBER AND TITLE 0622/03F Aerospace Propulsion Technology           Of Section 1           Section 2           Section 2      Section 2 <th colspan="3">2 Advanced Propulsion</th>		2 Advanced Propulsion							
EXhibit R-2a, RD1&E Project Justification       February 200         BUDGET ACTIVITY       O2 Applied Research       PROJECT NUMBER AND TITLE 0602203F Aerospace Propulsion       PROJECT NUMBER AND TITLE 3012 Advanced Propulsion         OCost (\$ in Millions)       FY 2006 Actual       FY 2007       FY 2009       FY 2010       FY 2011       FY 2012       PR J2017       PR J2017       PR J2017       FY 2010       FY 2011       FY 2013       Cost to Technology         3012       Advanced Propulsion Technology       19.272       29.825       21.984       21.639       23.203       23.141       22.936       23.461       Continuing         Quantity of RDT&E Articles       0 <t< th=""><th>Total</th></t<>					Total						
2012	Exhibit K-2a, RD 1&E Project Justification         February 200           BUDGET ACTIVITY 02 Applied Research         PE NUMBER AND TITLE 002203F Aerospace Propulsion Technology         Std 2 Advanced Propulsion Technology         St										
3012										Continuing	TBD
Note:			÷	ŷ	, , , , , , , , , , , , , , , , , , ,	Ĵ		Ŷ	-	Project 3012	
manag (U) <u>4</u> 1 H	ge cooperative CCE developments. A. Mission Description and Budget I This project develops combined/advan revolutionary propulsion options for the primary focus is on hydrocarbon-fuele capabilities of interest to both Departm	Item Justifica aced cycle airb aced rece. d engines cap aent of Defens	tion preathing high- These new engable of operations able of operations and NASA.	speed (up to l gine technolog ing over a bro Efforts inclu	Mach 4) and h gies will enabl ad range of fli de modeling, s	ypersonic (Ma e future high- ght Mach nun	ach 4 to 8+) pr speed/hyperso ibers. Techno	ropulsion tech onic weapons ologies develo	nologies to pr and aircraft co ped under this	ovide oncepts. The s program enal	
(U) . (U) .	MAJOR THRUST: Develop advance demonstration and enable the broad ap In FY 2006 and FY 2007, funding sup In FY 2006: Developed and demonstr closed loop controller. Tested flight v closed loop engine controls at Mach 5 options for scramjet start, including ga plasma ignition, and silane injection w engine control techniques, based on ra control logic, to ensure stable scramje flight weight, fixed geometry inlet scr In FY 2007: Continue development a control system with closed loop contro Continue evaluating options for scram fuel injection, plasma ignition, and silan	d fuel-cooled oplication of h oports significa- rated flight we veight scramje . Performed t as generator/h vith a mechani- opid shock trait t operation. D amjet engine nd demonstration oller. Continu- ujet start, inclu- ane injection	scramjet engin ypersonics to ant ground test eight engine co et engine with rajectory optin eat exchanger ical throat or a n identificatio Designed, fabri with improved tion of flight w the performing ding gas gene with a mechan	meet future w ting that will w omponents and flight weight a nization for fl system, barbo ir throttle. Ve n/ characterize cated, and inite operability to veight engine trajectory opti rator/heat exclicit	varfighter need wrap up in FY d a control sys fuel control va- ight test. Eva otage fuel injec- erified operation ation coupled tiated ground to o reduce flight components an imization for f hanger system air throttle. Co	Is. Note: 2007. tem with alves and luated ction, on of with fuel test of a test risk. and a light test. a, barbotage ontinue		_			<u>FY 2009</u> 1.245
	1 0	trol logic, to e	ensure stable s	cramjet opera mproved oper R-1	tion. Complet	te ground ce flight				Exhibit R-2a (P	E 0602203F)

	Exhibit R-2a, RDT&E Project	t Justification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace	Propulsion	PROJECT NUM 3012 Advan Technology		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	test risk. In FY 2008: Continue development and demonstration of flight weight engine advanced engine control logic. Continue performing trajectory optimization is evaluating options for scramjet start, including gas generator/heat exchanger sinjection, plasma ignition, and silane injection with a mechanical throat or air testing of advanced scramjet start techniques. Continue verification of operative techniques, based on rapid shock train identification/ characterization coupled ensure stable scramjet operation.	for flight test. Continue system, barbotage fuel throttle. Initiate design and ion of engine control				
(U)	In FY 2009: Continue development and demonstration of flight weight engine advanced engine control logic. Continue performing trajectory optimization is evaluating options for scramjet start, including gas generator/heat exchanger sinjection, plasma ignition, and silane injection with a mechanical throat or air testing of advanced scramjet start techniques. Continue verification of operative techniques, based on rapid shock train identification/ characterization coupled ensure stable scramjet operation.	for flight test. Continue system, barbotage fuel throttle. Complete ground ion of engine control				
(U) (U)	MAJOR THRUST: Conduct assessments, technology design trades, and sime combined cycle engines (CCEs) and advanced cycle airbreathing hypersonic into future missiles and into manned and unmanned air and space vehicle con development and demonstration of components to integrate scramjets with his rocket engines for efficient propulsion over a broad range of Mach numbers.	propulsion technologies cepts. CCEs require the	1.062	2.239	1.991	2.371
(U)	In FY 2006: Performed trade studies to determine military payoff and establis goals. Defined component and engine performance objectives to enable deve hypersonic flight demonstrators jointly with NASA and DARPA. Developed turbine-based and rocket-based CCEs, with initial emphasis on advanced inle capable of operating from Mach 0 to Mach 8. Designed sub-scale inlet test an	advanced components for ts for turbine-based CCEs				
(U)	In FY 2007: Continue trade studies to determine military payoff and establish goals. Continue defining component and engine performance objectives to en affordable hypersonic flight demonstrators jointly with NASA and DARPA. advanced components for turbine-based and rocket-based CCEs. Fabricate an inlets for turbine-based CCEs capable of operating from Mach 0 to Mach 8.	h component technology nable development of Continue development of				
	F	R-1 Line Item No. 8				

Exhibit R-2a, RDT&E Project Justification       DATE         BUDGET ACTIVITY       PE NUMBER AND TITLE       PROJECT NUMBER AND TITLE									
	DGET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospac	e Propulsion						
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U)	In FY 2008: Continue trade studies to determine military payoff and establish goals. Continue defining component and engine performance objectives to ena affordable hypersonic flight demonstrators jointly with NASA and DARPA. C advanced components for turbine-based and rocket-based CCEs. Complete test for turbine-based CCEs capable of operating from Mach 0 to Mach 8. Design a turbine-based and rocket-based CCEs.	ble development of Continue development of ting of advanced inlets							
(U)	In FY 2009: Continue trade studies to determine military payoff and establish goals. Continue defining component and engine performance objectives to ena affordable hypersonic flight demonstrators jointly with NASA and DARPA. C advanced components for turbine-based and rocket-based CCEs. Conduct test for turbine-based and rocket-based CCEs.	ble development of Continue development of							
(U) (U)	MAJOR THRUST: Develop robust hydrocarbon fueled scramjet engine comp to improve performance, operability, durability, and scalability for future missi vehicles. Note; Starting in FY 2008, efforts shift towards much larger hot sec voluminous test data will be required to correlate the combustion scaling pheno baseline configuration to provide the knowledge to scale the scramjet configur applications potentially up to space launch.	les and for aerospace tion testing and pmena to the original	9.665	10.595	18.805	18.023			
(U)	In FY 2006: Developed advanced engine components to improve scramjet oper establish scramjet scaling laws for reusable applications. Developed variable and decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust optic and initiated test of scramjet combustors sized for reusable applications with in efficiency. Developed low internal drag flame stabilization devices and flight	eometry techniques to ons for CCEs. Fabricated nproved structural							
(U)		ve scramjet operating nue development of Mach 3.5 to provide ble applications with gine concepts. Continue							
(U)	In FY 2008: Continue development of advanced engine components to improve margin and to establish scramjet scaling laws for reusable applications. Contin	ve scramjet operating							
Pro	oject 3012	1 Line Item No. 8 Page-5 of 44			Exhibit R-2a (I	PF 0602203F)			

	Exhibit R-2a, RDT&E Project Just	ification	DAT	E February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion		MBER AND TITLE Inced Propulsio /	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach robust options for CCEs. Complete test of scramjet combustors 5 to 10 times baselin applications with improved structural efficiency. Initiate development of improved d concepts. Continue development of low internal drag flame stabilization devices and components.	e size for reusable urability engine	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue development of advanced engine components to improve scra margin and to establish scramjet scaling laws for reusable applications. Complete de variable geometry techniques to decrease scramjet take-over from Mach 4.5 to Mach robust options for CCEs. Continue sector testing of large scale scramjet combustors baseline size for reusable applications with improved structural efficiency. Continue improved durability engine concepts. Continue development of low internal drag fla devices and flight test engine components.	velopment of 3.5 to provide 20 to 50 times development of			
(U) (U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Information Assurance Initiative. In FY 2006: Implemented improvements supporting technology infrastructure securit electronic security of doors, security of video teleconferencing systems and for a cent systems and separate research and development network. In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		0.000	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced High Speed Propulsion Development. In FY 2006: Not Applicable. In FY 2007: Enhance the nation's ability to test and analyze high speed propusion sy scramjets and combined cycle engines. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0.000 stems such as	0.996	0.000	0.000
(U)	CONGRESSIONAL ADD: X-51 Robust Scramjet Flight Research. In FY 2006: Not Applicable. In FY 2007: Investigate the integration of alternative high speed combined cycle eng	0.000	3.886	0.000	0.000
Pro	pject 3012 Page-	tem No. 8 6 of 44 64		Exhibit R-2a (	PE 0602203F)

		Exhibit	: R-2a, RD1	&E Projec	t Justific	ation			DATE	February	2007
	GET ACTIVITY Applied Research					NUMBER AND TI 02203F Aeros	on	PROJECT NUMBER AND TITLE 3012 Advanced Propulsion Technology			
(U)	<b>B. Accomplishments/Planned</b> (such as circular and rectangular efforts.	-		t demonstration	n under X-51	follow-on	<u>FY 20</u>	<u>06</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable. Total Cost						19.2	72	29.825	21.984	21.639
(U)	<u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> FY 2007 <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	FY 2011 Estimate	FY 2012 Estimate		<u>Cost to</u> <u>Complete</u>	
(U) (U)	Related Activities: PE 0601102F, Defense Research Sciences. PE 0602201F, Aerospace										-
(U)	Flight Dynamics. PE 0602500F, Multi-Disciplinary Space Tech.										
(U)	PE 0602602F, Conventional Munitions. PE 0602702E, Tactical										
(U)	Technology. PE 0603211F, Aerospace Structures.										
(U)	PE 0603216F, Aerospace Propulsion and Power Technology.										
	PE 0603601F, Conventional Weapons Technology.										
	Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) Executive										
Pro	ject 3012				R-1 Line Item Page-7 of 4					Exhibit R-2a (	PE 0602203F)

Exhibit R-2a, RDT&E P	Project Justification	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3012 Advanced Propulsion Technology
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
Committee. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.		
(U) <b>D. Acquisition Strategy</b> Not Applicable.		
Project 3012	R-1 Line Item No. 8 Page-8 of 44	Exhibit R-2a (PE 0602203F)

Description         February 2007           DDGET ACTIVITY         PE NUMBER AND TITLE         PROJECT NUMBER AND TITLE         PROJECT NUMBER AND TITLE           2 Applied Research         Odd2037 Aerospace Propulsion         BY 2012         FY 2013         Cost to         Total           2 Applied Research         Cost (\$ in Millions)         FY 2006         FY 2007         FY 2008         FY 2009         FY 2011         FY 2012         FY 2013         Cost to         Total           2 Main Strand         Estimate         Estimate         Estimate         Estimate         Estimate         Cost to         Continuing T           2 Main Strand         0 </th <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>DATE</th> <th></th> <th></th>										DATE		
2 Applied Research       De602203F Acrospace Propulsion       2048 Fuels and Lubrication <ul> <li>Cost (\$ in Millions)</li> <li>Artual</li> <li>Estimate</li> <li>Esti</li></ul>			Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on				February	2007
Cost (s in Millions)         Actual         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Complete           248         Fuels and Lubrication         20.723         24.599         17.349         26.088         26.678         19.067         17.954         18.301         Complete           Quantity of RDT&R Arricles         0 <td< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>n</th></td<>												n
Actual         Estimate         Estimate <thestimate< th="">         Estimate         <t< th=""><th></th><th>Cost (\$ in Millions)</th><th>FY 2006</th><th>FY 2007</th><th>FY 2008</th><th>FY 2009</th><th>FY 2010</th><th>FY 2011</th><th>FY 2012</th><th>FY 2013</th><th>Cost to</th><th>Total</th></t<></thestimate<>		Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Quantity of RDT&E Articles         0 </td <td></td> <td>Cost (\$ III MIIIIOIIS)</td> <td>Actual</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Estimate</td> <td>Complete</td> <td></td>		Cost (\$ III MIIIIOIIS)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Dete: The funding in this project has been increased to provide emphasis on component development in support of adaptive cycle technologies. Funds for the FY 2007         ingressionally-directed High Energy Laser for Detection Inspection and Non-Destructive Testing in the amount of \$2.7 million are in the process of being moved to the stone Advanced Research Projects Agency, Projects Agency, Prom PE 062203F, Acrospace Propulsion, for execution.         In Advanced Research Projects Agency, Prom PE 062203F, Acrospace Propulsion, for execution.         In Advanced Litem Justification         This project evaluates fuels, lubricants, mechanical systems, and combustion concepts for advanced turbine engines, scramjets, puble detonation, and combustion acot of ownership. Applications include missiles, aircraft, sustained high-speed vehicles, and responsive space launch. Analytical and experimental areas of emphasis include fuels and fuels logistics, lubricants, bearings, electromagnetic rotor, oil-less engine technology to quadaptive cycle technologies. This effort develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs.         B. Accomplishments/Planned Program (5 in Millions)       FY 2005       FY 2007       FY 2008         MAOR THRUST: Develop low-cost additive and fuel system approaches to improve fuel properties and specifications for anadptive cycle engine architecture. Design, fabricate, and test of key thermal management technologies. Note: Increased flunding in FY2008 and out due to emphasis on component development in support of adaptive cycle engine architecture. Design, fabricate, and test of key thermal management models, and improve materials and coatings. Developed initial engine thermal man				24.599	17.349	26.088				18.301	Continuing	TB
ngressionally-directed High Energy Laser for Detection Inspection and Non-Destructive Testing in the amount of \$2.7 million are in the process of being moved to the effense Advanced Research Projects Agency, from PE 062203F, Aerospace Propulsion, for execution.           D         AMision Description and Budget (Ima) ustification           This project evaluates fuels, lubricants, mechanical systems, and combustion concepts for advanced turbine engines, scramjets, pulse detonation, and combined cycle engines, and technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, sustained high-speed velves space launch. Analytical and experimental areas of emphasis include fuels and fuels logistics, lubricants, bearings, electromagnetic rotor, oil-less engine technology, optical diagnostics, fundamental combustion 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.           D         Accomplishments/Planned Program (5 in Millions)         EY 2006         EY 2007         EY 2008         EY 2009           D         MAJOR THRUST: Develop Iow-cost additive and fuel system approaches to improve fuel propertics         1.751         2.162         3.053         6.76           and to ckapand the flight envelope for manned and unmanned aircraft. Determine fuel cooling         requirements and specifications for an adaptive cycle engine architecture. Design, fabricate, and lest of key thermal manageme			ş	0	Ŷ	Ŷ.	ů	ş	ů	Ŷ		
This project evaluates fuels, lubricants, mechanical systems, and combustion concepts for advanced turbine engines, scramjets, pulse detonation, and combined cycle engines, and technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. Applications include missiles, aircraft, sustained high-speed vehicles, and responsive space launch. Analytical and experimental areas of emphasis include fuels and fuels logistics, lubricants, bearings, electromagnetic rotor, oil-less engine technology, optical diagnostics, fundamental combustion concepts for advanced curbic and operate over a broad range of conditions. Advanced combustion concepts must be cost-effective, and perports 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.  10 <b>B. Accomplishments/Planned Program (§ in Millions) FY 2006 FY 2007 FY 2007 FY 2008 FY 2007 FY 2008 FY 2007 FY 2008 FY 2007 FY 2008 FY 2007 FY 2008 FY 2007 FY 2008 FY 2007 FY 2008 FY 2007 FY 2008 FY 2007 FY 2006 Conducted lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Inite effort to validate component engability to 900 degrees Fahrenheit including thermal stability additives, the ledoxygenation, advanced alternative energy fuels, and improve materials and coatings. Initiae effort to validate component engability to 900 degrees Fahrenheit including thermal stability additives, the ledoxygenation, advanced alternative energy fuels, and improved materials and coatings. Initiae effort to validate component engability to 900 degrees Fahrenheit including thermal stability additives, the ledoxygenation, advanced alter</b>	Congression Defense Adv	ally-directed High Energy Lase vanced Research Projects Agend	er for Detectio cy, from PE 0	n Inspection at 52203F, Aeros	nd Non-Destr	uctive Testing	in the amoun		-			
D       B. Accomplishments/Planned Program (\$ in Millions)       FY 2006       FY 2007       FY 2008       FY 2009         D)       MAJOR THRUST: Develop low-cost additive and fuel system approaches to improve fuel properties and to expand the flight envelope for manned and unmanned aircraft. Determine fuel cooling requirements and specifications for an adaptive cycle engine architecture. Design, fabricate, and test of key thermal management technologies. Note: Increased funding in FY2008 and out due to emphasis on component development in support of adaptive cycle technologies.       Image: The technologies and technologies.       Image: The technologies and technologies.       Image: The technologies and technologies.       Image: The technologies and technologies.       Image: The technologies and technologies.       Image: The technologies and technologies.       Image: The technologies and technologies.       Image: The technologies and technologies.       Image: The technologies and technologies and technologies.       Image: The technologies and technologies and technologies.       Image: The technologies and technologies and technologies.       Image: The technologies and technologies and technologies.       Image: The technologies and technologies and technologies.       Image: The technologies and technologies and technologies and technologies and technologies and technologies.       Image: The technologies and technologies an	and cos emphas detonat concep	st of ownership. Applications in sis include fuels and fuels logist tions. Fuels and lubricants for t ots must be cost-effective, durab	nclude missile tics, lubricants hese engines r le, and reduce	s, aircraft, sus , bearings, ele nust be therm pollutant emi	tained high-spectromagnetic ally stable, co ssions. A por	peed vehicles, rotor, oil-less st-effective, an tion of this pro-	and responsiv engine techno nd operate ove oject supports	e space launch ology, optical d er a broad rang adaptive cycle	n. Analytical a liagnostics, fu ge of condition e technologies	and experiment andamental controls. Advanced s. This effort d	ntal areas of mbustion, and combustion evelops	
component development in support of adaptive cycle technologies. In FY 2006: Conducted lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Developed initial engine thermal management models, aiming toward system-level models of advanced aircraft. Developed laboratory-scale combustion tests for evaluating combustion performance of fuels and additives at low fuel and air temperatures. I) In FY 2007: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Initiate effort to validate component performance models on aircraft thermal management simulator. Continue to develop approaches to assess and improve additive combustion behavior at low fuel and air temperatures. Test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems. R-1 Line Item No. 8 Project 3048 Project 304 R-2a (PE 0602203	(U) <u>B. Acc</u> (U) MAJO and to require	complishments/Planned Progr PR THRUST: Develop low-cost expand the flight envelope for a ements and specifications for an	ram (\$ in Mill t additive and manned and u a adaptive cycl	<b>ions)</b> fuel system ap nmanned aircr e engine archi	pproaches to in aft. Determin itecture. Desi	mprove fuel p ne fuel cooling gn, fabricate, a	roperties	<u>FY 20</u>	<u>06 FY</u>	<u> 2007</u>	<u>FY 2008</u>	<u>FY 2009</u> 6.764
I) In FY 2007: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Initiate effort to validate component performance models on aircraft thermal management simulator. Continue to develop approaches to assess and improve additive combustion behavior at low fuel and air temperatures. Test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems.          Project 3048       R-1 Line Item No. 8 Page-9 of 44	compo U) In FY 900 de energy models combu	onent development in support of 2006: Conducted lab-scale eva grees Fahrenheit including ther v fuels, and improved materials s, aiming toward system-level n istion tests for evaluating combi	adaptive cycl luation of app mal stability a and coatings. nodels of adva	e technologies roaches to inc dditives, fuel Developed in nced aircraft.	s. rease JP-8 ten deoxygenation itial engine the Developed la	nperature capa n, advanced al ermal manage aboratory-scale	bility to ternative ment					
Project 3048 Page-9 of 44 Exhibit R-2a (PE 0602203	(U) In FY capabi alterna perforn assess	2007: Continue conducting lab lity to 900 degrees Fahrenheit in tive energy fuels, and improved mance models on aircraft therm and improve additive combustion	ncluding therr l materials and al management on behavior at	nal stability ac l coatings. Ini at simulator. C low fuel and	lditives, fuel c itiate effort to Continue to de air temperatu	deoxygenation validate comp evelop approad	, advanced ponent ches to					
	Project 3048	3					3				Exhibit R-2a (P	'E 0602203F`
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T ACTIVITY plied Research	PE NUMBER AND TITLE 0602203F Aerospac	e Propulsion		IBER AND TITLE	
apability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxy lternative fuels, and improved materials and coatings. Continue effort to validate co erformance models on aircraft thermal management simulator. Complete the devel pproaches to assess and improve additive combustion behavior at low fuel and air to continue to test fuel candidates in bench scale rigs simulating advanced high Mach p and the Highly Efficient Embedded Efficient Turbine Engine. Develop a robust mech ntegrated engine thermal management system (mechanical and fuel systems) for opti-	vgenation, advanced omponent opment of emperatures. oropulsion systems chanical and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
n FY 2009: Continue conducting lab-scale evaluation of approaches to increase JP- apability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxy lternative energy fuels, and improved materials and coatings. Continue effort to va erformance models on aircraft thermal management simulator. Continue to test fue ench scale rigs simulating advanced high Mach propulsion systems and the Highly 'urbine Engine. Conduct full-scale component rig testing of mechanical component	genation, advanced lidate component el candidates in Efficient Embedded ts with prototype				
		1.085	1.339	1.273	1.721
Iternative energy resources to reduce emissions in laboratory scale combustion rigs igher-pressure laboratory-scale combustion tests and diagnostics for sub-micron pa	. Developed				
n FY 2007: Complete assessing novel fuel additives including nano-technologies a rom alternative energy resources to reduce emissions in laboratory scale combustion igher-pressure measurements of additive and fuel effects on sub-micron particulate	n rigs. Initiate				
n FY 2008: Complete assessing novel fuel additives including nano-technologies to a laboratory scale combustion rigs. Initiate improvement of combustion models for	kerosene fuels.				
	Item No. 8 10 of 44			Exhibit R-2a (F	PE 0602203E)
	Accomplishments/Planned Program (\$ in Millions) apability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxy ternative fuels, and improve materials and coatings. Continue effort to validate co- grorance models on aircraft thermal management simulator. Complete the devel proaches to assess and improve additive combustion behavior at low fuel and air to ontinue to test fuel candidates in bench scale rigs simulating advanced high Mach p and the Highly Efficient Embedded Efficient Turbine Engine. Develop a robust med- tegrated engine thermal management system (mechanical and fuel systems) for opi- erformance and durability at sustained supersonic cruise conditions. a FY 2009: Continue conducting lab-scale evaluation of approaches to increase JP- upability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxy ternative energy fuels, and improved materials and coatings. Continue effort to va- erformance models on aircraft thermal management simulator. Continue to test fue- ench scale rigs simulating advanced high Mach propulsion systems and the Highly urbine Engine. Conduct full-scale component rig testing of mechanical component bricants. Conduct simulated high-Mach tests of an integrated thermal management echanical system components. IAJOR THRUST: Develop advanced additive approaches to reduce engine emission cluding nano-scale additives), as well as advanced emission diagnostic test protoc of FY 2006: Assessed novel fuel additives including nano-technologies and fuels de ternative energy resources to reduce emissions in laboratory scale combustion rigs gher-pressure laboratory-scale combustion tests and diagnostics for sub-micron pa- vestigations. a FY 2007: Complete assessing novel fuel additives including nano-technologies at om alternative energy resources to reduce emissions in laboratory scale combustion gher-pressure measurements of additive and fuel effects on sub-micron particulate ombustion. a FY 2008: Complete assessing novel fuel	Accomplishments/Planned Program (\$ in Millions) IFY 2008: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature pability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced ternative fuels, and improved materials and coatings. Continue effort to validate component rformance models on aircraft thermal management simulator. Complete the development of oproaches to assess and improve additive combustion behavior at low fuel and air temperatures. ontinue to test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems ad the Highly Efficient Embedded Efficient Turbine Engine. Develop a robust mechanical and tegrated engine thermal management system (mechanical and fuel systems) for optimum engine erformance and durability at sustained supersonic cruise conditions. IFY 2009: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature upability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced ternative energy fuels, and improved materials and coatings. Continue to test fuel candidates in ench scale rigs simulating advanced high Mach propulsion systems and the Highly Efficient Embedded urbine Engine. Conduct full-scale component rig testing of mechanical components with prototype bricants. Conduct simulated high-Mach tests of an integrated thermal management system and echanical system components. IAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature neluding nano-scale additives), as well as advanced emission diagnostic test protocols. IFY 2006: Complete assessing novel fuel additives including nano-technologies and fuels derived from ternative energy resources to reduce emissions in laboratory scale combustion rigs. Initiate gher-pressure measurements of additive and fuel effects on sub-micron particulate generation during mbustion. IFY 2008: Complete assessing novel fuel additives includin	Accomplishments/Planned Program (\$ in Millions) FY 2008: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature upability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced ternative fuels, and improved materials and coatings. Continue effort to validate component rformance models on aircraft thermal management simulator. Complete the development of poroaches to assess and improve additive combustion behavior at low fuel and air temperatures. ontinue to test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems ad the Highly Efficient Embedded Efficient Turbine Engine. Develop a robust mechanical and the Fighly Efficient Embedded Efficient Turbine Engine. Develop a robust mechanical and the Highly Efficient Embedded Efficient Turbine Engine. Develop a robust mechanical and tegrated engine thermal management system (mechanical and fuel systems) for optimum engine rformance models on aircraft thermal management simulator. Continue to test fuel candidates in ench scale rigs simulating advanced high Mach propulsion systems and the Highly Efficient Embedded urbine Engine. Conduct full-scale component rig testing of mechanical components with prototype bricants. Conduct simulated high-Mach tests of an integrated thermal management system and echanical system components. IAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature netuding nano-scale additives), as well as advanced emission diagnostic test protocols. IFY 2005: Assessed novel fuel additives including nano-technologies and fuels derived formatereative energy resources to reduce emissions in laboratory scale combustion rigs. Developed gher-pressure laboratory-scale combustion tests and diagnostics for sub-micron particulate vestigations. IFY 2008: Complete assessing novel fuel additives including nano-technologies to reduce emissions laboratory scale combustion rigs. Initiate improvement of combustio	Accomplishments/Planned Program (\$ in Millions) FY 2008: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature pability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced ternative fuels, and improve materials and coatings. Continue effort to validate component of proroaches to assess and improve additive combustion behavior at low fuel and air temperatures. ontinue to test fuel candidates in hench scale rigs simulating advanced high Mach propulsion systems ad the Highly Efficient Embedded Efficient Turbine Engine. Develop a robust mechanical and tegrated engine thermal management simulator. Complete the development of protoches to assess and improve additive combustion of approaches to increase JP-8 temperatures. ontinue to test sustained supersonic cruise conditions. IFY 2009: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature pability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced ternative energy fuels, and improved materials and coatings. Continue effort to validate component erformance models on aircraft thermal management simulator. Continue to test fuel candidates in ench scale rigs simulating advanced bigh Mach propulsion systems and the Highly Efficient Embedded turbine Engine. Conduct full-scale component rig testing of mechanical components with prototype bricants. Conduct subject Mach tests of an integrated thermal management system and echanical system components. IAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature neluding nano-scale additives, as well as advanced combustion rigs. Developed gher-pressure laboratory-scale combustion tigs. Initiate gher-pressure laboratory-scale combustion star and diagnostics for sub-micron particulate vestigations. IFY 2007: Complete assessing novel fuel additives including nano-technologies and fuels derived on alternative energy resources to reduce	Accomplishments/Planned Program (\$ in Millions) FY 2008: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature pability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced termative fuels, and improved materials and coatings. Continue effort to validate component rformance models on aircraft thermal management simulator. Complete the development of sproaches to assess and improve additive combustion behavior at low fuel and air temperatures. ontinue to test fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems of the Highly Efficient Turbine Engine. Develop a robust mechanical and tegrated engine mermating and containes. Continue effort to validate component erformance and durability at sustained supersonic cruise conditions. FY 2009: Continue conducting lab-scale evaluation of approaches to increase JP-8 temperature papability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced ternative energy fuels, and improved materials and coatings. Continue effort to validate component erformance models on aircraft thermal management simulator. Compute to test fuel candidates in ench scale rigs simulating advanced high Mach propulsion systems and the Highly Efficient Embedded urbine Engine. Conduct full-scale component rig testing of mechanical components with prototype bricants. Conduct simulated high-Mach tests of an integrated thermal management system and echanical system components. IAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature netwistigations. IFY 2007. Complete assessing novel fuel additives including nano-technologies and fuels derived om alternative energy resources to reduce emissions in laboratory scale combustion rigs. Initiate gher-pressure laboratory-scale combustion site indomy scale combustion rigs. Initiate gher-pressure measurements of additive and fuel effects on sub-micron particulate exera

	Exhibit R-2a, RDT&E Project J	ustification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospac	e Propulsion		MBER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2009: Continue higher-pressure measurements of additive and fuel effects particulate generation during combustion. Initiate study of NOx/soot tradeoffs in Continue improvement of combustion models for kerosene fuels		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Study and evaluate low-cost approaches to reduce fuel logis simplify logistics and reduce cost (including field and on-board additive injection existing fuel additive packages), as well as study fuel logistics vulnerabilities and mitigation technologies.	s and improvements to	1.085	1.339	1.273	1.721
(U)	In FY 2006: Assessed fuel additives optimization for logistics footprint reduction performance of Fischer-Tropsch (F-T) and other alternative fuels for aircraft and Completed investigation of supply chain biological contamination and the impace Evaluated nano-technology fuel sensors and biological mitigation techniques. Co of advanced field diagnostics techniques for fuel properties and bio-contamination	other field hardware. on fuel logistics. ompleted development n.				
	In FY 2007: Continue to investigate performance of F-T and other alternative fu other field hardware. Continue evaluation of advanced nano-technology fuel set fuel additives, and novel detection and mitigation technologies for biological gro	sors, nano-technology				
(U)		ide bio-derived fuels. systems and ground cher-Tropsch fuels for v fuel sensors,				
	In FY 2009: Continue to investigate performance of biomass-derived fuels for an hardware. Initiate extension of knowledge base to other alternative fuels, such as biomass. Continue development of bioreactors to simulate biological growth in a ground storage facilities. Continue development of knowledge base for certificate fuels for all Air Force tactical vehicles.	those derived from ircraft fuel systems and				
(U) (U)	MAJOR THRUST: Investigate hydrocarbon and other high energy density fuels	for advanced and	0.543	0.670	0.637	0.861
(U)	combined cycle engines for high-speed aerospace vehicles and low-cost boost ap In FY 2006: Assessed advanced hydrocarbon propellant stability under high hea advanced rockets and combined cycle engines.	plications. t flux conditions for				
(U)	In FY 2007: Continue to assess advanced hydrocarbon propellant stability under	high heat flux				
Broi		ine Item No. 8 ige-11 of 44			Exhibit R-2a (I	PE (1602203E)

Exhibit R-2a, RDT&E Project Justification       DATE         BUDGET ACTIVITY       PE NUMBER AND TITLE       PROJECT NUMBER							
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospac		PROJECT NUM	on		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> conditions. Collect improved fuel property data for hydrocarbon propellar In FY 2008: Complete study of refined kerosene propellants under high he continuing to study synthesized high-energy hydrocarbons. Continue to in and share with industry to improve design tools.	eat flux conditions, while	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Continue study of high-energy hydrocarbon propellant candid physical property database for kerosene propellants at high pressure. Cont physical property for high energy hydrocarbons and improve physical prop	tinue to collect improved					
(U) (U)	MAJOR THRUST: Develop, test, and evaluate revolutionary combustor a gas turbine, pulsed detonation, and combined cycle engines for missiles, m systems, and reuseable access to space; perform payoff analyses and confi systems; and evaluate the combustion and emissions characteristics of fuel	nanned and unmanned guration trade studies for these	3.781	4.695	4.436	5.996	
(U)	In FY 2006: Evaluated advanced combustion system performance at reali- Investigated larger-scale inter-turbine burner concepts at relevant engine of increase mission flexibility. Developed a Pulse Detonation Engine (PDE) Conducted experiments to validate chemical kinetics of practical fuels at h Performed modeling and simulation of advanced combustion systems to de optimize compact combustor, and augmentor designs, and to understand p combustion processes. Evaluated and developed novel lightweight, high p concepts.	perating conditions to turbine-based hybrid concept. high pressure and temperature. ecrease design cycle time, hysical parameters controlling					
(U)	In FY 2007: Continue evaluating advanced combustion system performant conditions. Continue investigating inter-turbine burning concepts for large Continue integration of PDE into turbine-based hybrid concept. Evaluate combustor, augmentor, and PDE concepts using modeling and simulation	e gas turbine engines. and optimize advanced					
(U)	In FY 2008: Demonstrate small-scale inter-turbine burner (ITB) concepts environment. Investigate the scalability of inter-turbine burners for large e pulsed detonation/hybrid turbine concept performance with component fab Investigate combustor and augmentor systems for high-altitude low-high r and optimize advanced combustor, augmentor, and PDE concepts using m	in a relevant engine ngines. Assess an integrated prication and evaluation. nach applications. Evaluate					
(U)		tic operating conditions. esigns of inter-turbine burning					
Dro	ject 3048	R-1 Line Item No. 8 Page-12 of 44			Exhibit R-2a (I		

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007
	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602203F Aerospac	e Propulsion		MBER AND TITLE and Lubrication	
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> detonation/hybrid turbine. Evaluate and optimize advanced combustor, augmentor, using modeling and simulation tools covering wider flight conditions and application	_	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop approaches to extend the life of endothermic fuels and components for sustained supersonic and reusable hypersonic cruise applications.		0.543	0.670	0.637	0.861
	In FY 2006: Evaluated, at a laboratory scale, approaches to improve fuel heat sink management capability for high speed systems. Evaluated surface/catalyst effects of improve fuel heat sink capability and increase fuel system life. Assessed unconvent increase fuel heat sink, such as steam reforming.	n coke reduction to tional approaches to				
	In FY 2007: Continue development of improved surfaces/catalysts to mitigate coke fuel heat sink capability. Continue assessment of unconventional approaches to inc and minimize regenerative cooling heat loads, including low heat rejection structure	rease fuel heat sink				
(U)	In FY 2008: Evaluate improved coke-mitigating surfaces/catalysts with 2nd genera fuels in bench-scale heat exchanger rigs. Assess unconventional approaches to incl and minimize regenerative cooling heat loads in panel tests. Initiate study of relation structure/properties and combustion behavior including blowout.	tion endothermic ease fuel heat sink				
:	In FY 2009: Continue bench-scale tests to evaluate improved surfaces/catalysts for endothermic fuels. Continue assessment of unconventional approaches to increase minimize regenerative cooling heat loads. Continue study of relationship between f structure/properties and combustion behavior including blowout.	fuel heat sink and				
	MAJOR THRUST: Develop and demonstrate optical, electromechanical, and laser sensors for application to revolutionary propulsion technologies.	diagnostic tools and	0.681	0.840	0.799	1.080
(U)	In FY 2006: Applied advanced laser diagnostics for accurate measurements inside combustion systems to improve design cycle time. Developed sensor technologies gas turbine engine combustion systems for enhanced operability, increased durabili Investigated high intensity laser light with matter for micromachining and diagnost	for use in intelligent ty and performance.				
(U)	In FY 2007: Continue application of advanced diagnostics in a relevant gas turbing environment. Apply diagnostics to sensor development and validate sensors in rele engine system. Conduct experiments to obtain benchmark-quality data for improve modeling and simulation tools.	combustion system vant gas turbine				
(U)	In FY 2008: Demonstrate high-bandwidth (e.g., MHz-rate) planar laser-induced flu	orescence for				
Proje		e Item No. 8 -13 of 44			Exhibit R-2a (F	PE 0602203F)

	Exhibit R-2a, RDT&E Proj	ect Justification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospac	e Propulsion	PROJECT NUM		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> high-speed digital imaging of key combustion species in fundamental labor engine environments. Apply terahertz radiation (T-rays) for combustion to non-destructive inspection/evaluation of turbine engine components. Inter- next-generation combustion diagnostics to support RDT&E of augmentor	emperature sensing and grate current and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Develop high-speed techniques for measuring carbon monox oxidiation/combustion efficiency in near-constant-volume-combustion tur ultrafast (e.g., femtosecond), ultraintense (e.g., terawatt) laser systems to g for soot-mitigation studies and dense-fuel-spray imaging. Develop multi- imaging to understand and improve fuel sprays in combustor, augmentor, applications.	tide (CO) to evaluate CO bine environments. Exploit generate ultrashort x-ray bursts pulse femtosecond ballistic				
(U) (U)	MAJOR THRUST: Develop, test, and qualify advanced turbine engine lu DoD. Establish target requirements and transition opportunities for new of agencies, industry, and users. Generate and maintain military specification lubricants, as well as continued field support activities for aviation lubrication operational units.	ils by working with DoD ns for aviation engine	2.105	2.598	2.470	3.339
(U)	In FY 2006: Developed and tested advanced bearing and lubrication syst materials for improved engine performance, affordability, and engine heal applicable to man-rated, expendable, and Unmanned Aerial Vehicle (UAV focused on enhanced 5 centiStokes (cSt) high thermal stability (HTS) lubr elastomer compatibility test method. Designed test approaches for enhance for new, legacy, and commercial turbine engines. Developed Technology 7cSt ester lubricant for high Mach/high temperature military and commercial prototype Joint Oil Program (JOP) lubricants with mechanical hardware in demonstration engines.	th monitoring, which are <i>I</i> ) turbine engines. Testing icant candidates and new eed high thermal stability oils Development Roadmap for cial turbine engines. Tested				
(U)	In FY 2007: Begin technology insertion of advanced bearing and lubricat components, and materials for improved engine performance, affordability monitoring into demonstrator cores and engines. Continue testing to focu mechanical systems for man-rated, expendable, and UAV turbine engines development for high Mach/high temperature military and commercial tur support demonstration of JOP lubricants in new fighter asset engines. Def and test methods for DoD lubricants to support new fighter engines.	y, and engine health s and develop lubricants and . Initiate 7cSt ester lubricant bine engines. Coordinate and				
	ject 3048	R-1 Line Item No. 8 Page-14 of 44			Exhibit R-2a (I	

Exhibit R-2a, RDT&E P	DATE February 2007				
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace	e Propulsion	PROJECT NUM		
<ul> <li>(U) B. Accomplishments/Planned Program (\$ in Millions)</li> <li>(U) In FY 2008: Complete qualification testing of the enhanced 5cSt esterengine program and draft new oil specification. Ramp up qualification preparation of FY11 engine demo. Develop an integrated and effective system with prognostics capability to address critical DoD safety, read concerns. Conduct technology assessment of long-term, low-temperate engine lubricants and develop concepts for efficient mechanical system turbine engines.</li> </ul>	testing of hi-mach 7cSt ester in e bearing / oil health monitoring liness, and life-cycle cost ture (hi-altitude) performance of n for highly efficient embedded	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U) In FY 2009: Finalize and field new enhanced 5cSt oil specification. C new hi-mach 7cSt ester lubricant. Demonstrate an integrated bearing / system in full-scale setting and validate life models. Fabricate and test highly efficient embedded turbine engine.</li> <li>(U)</li> </ul>	oil health monitoring / prognostic				
(U) MAJOR THRUST: Develop and test advanced bearing material techn	ology and bearing concepts for	2.361	2.914	2.771	3.745
<ul> <li>small, intermediate, and large-sized turbine engine applications.</li> <li>(U) In FY 2006: Conducted airfoil bearing testing of large shaft diameter and rotor size limitations of this technology. Developed and tested aff for small-, intermediate-, and large-sized turbine engine applications. simulation tools for advance design, which will shorten development t for mechanical and electromagnetic rotor support and power generation bearings for advanced engine rotor support and power generation. Ini (metal/ceramic) bearing technology for the new fighter demonstrator e JOP. Studied mechanical systems and thermal management concepts cycle engines.</li> </ul>	Fordable rotor support technology Improved modeling and ime, and reduce test requirements on systems. Modeled airfoil tiated full-scale tests of hybrid engines with lubricant from the				
(U) In FY 2007: Conduct airfoil bearing tests in larger shaft diameter size rotor size limitations of this technology. Develop and test of affordabi small-, intermediate-, and large-sized turbine engine applications. Val tools to advance design, shorten development time, and reduce test rec electromagnetic rotor support and power generation systems. Improve bearings and initiate evaluation of insertion opportunities for advanced generation. Transition/transfer airfoil bearing technology to bearing a Demonstrate hybrid (metal/ceramic) bearing and JOP lubricants in new Initiate programs for hardware needed for optimum thermal protection	le rotor support technology for lidate modeling and simulation quirements for mechanical and e the modeling of airfoil shaft l engine rotor support and power nd engine companies. w fighter demonstrator engines.				
Project 3048	R-1 Line Item No. 8 Page-15 of 44			Exhibit R-2a (	

Exhibit R-2a, RDT&E Project Justification						DATE February 2007		
BUDGET ACTIVITYPE NUMBER AND02 Applied Research0602203F Aero			e Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication				
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) temperature turbine engines and accelerators. Expand the previous studies of and power generation for turbine and combined cycle engines.	of advanced rotor support	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2008: Demonstrate new fatigue and spall propagation resistant bearin demo engines with enhanced 5cSt oil. Conduct subscale fatigue life and spa bearing materials with hi-mach 7cSt oil candidates. Develop preliminary de conduct trade study of energy efficient mechanical system components (ie. 1 magnetic bearing) for highly efficient embedded turbine engine.	Il propagation studies of sign of propfan gearbox and						
	In FY 2009: Complete subscale fatigue life and spall propagation studies of hi-mach 7cSt oil candidates and begin full-scale tests. Fabricate and test pro mechanical system components and complete detailed design for highly effi- engine.	pfan gearbox. Down select						
(U) (U)	CONGRESSIONAL ADD: Ultrafast, Ultraintense Laser Microfabrication a	and Diagnostics (formerly	1.358	0.996	0.000	0.000		
	Intense, Ultrafast Laser Microfabrication and Diagnostics). In FY 2006: Developed technology to exploit characteristics of intense, ultr weapons systems. Investigated these systems for use in gas turbine engine of new generation of extreme light diagnostics that can be used to analyze and development and validation of system design and life prediction models, and fleet maintenance.	diagnostics. Developed a evaluate materials, aid in the d perform inspections for						
(U)	In FY 2007: Continue to establish the technical base required to evaluate an ultraintense lasers for fabrication, inspection, and repair of components for a other weapon systems.	-						
(U) (U) (U)	In FY 2009: Not Applicable. In FY 2009: Not Applicable.							
(U)	CONGRESSIONAL ADD: Wavelength Agile Spectral Harmonic Oxygen In FY 2006: Designed, fabricated, and tested a second generation oxygen seconcentration in high-performance fuel tanks. Conducted environmental test simulated fuel tank conditions and performed Category A flight testing to air design, resulting in a third generation sensor design. Also conducted an evaluence sensor specifications and certification plan.	ensor to measure oxygen sting of the sensor under id in modification of the	0.970	0.000	0.000	0.000		
(U)	In FY 2007: Not Applicable.							
Pro	ject 3048	R-1 Line Item No. 8 Page-16 of 44			Exhibit R-2a (F	PE 0602203F)		

Exhibit R-2a, RDT&E Pr	DATE	DATE February 2007				
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITL 0602203F Aerospa			BER AND TITLE		
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Hybrid Bearings.</li> <li>(U) In FY 2006: Developed advanced hybrid bearing technology for use in engines. Conducted bearing fatigue life testing of advanced Pyrowear 6 P675 heat treatment optimization and characterization. Developed critice Nitride (Si3N4) bearing balls, and experimentally validated models. Al Non-destructive Evaluation (NDE) methods for Si3N4 bearing balls and performance testing of advanced hybrid bearings. Note: Moved to PE</li> </ul>	575 (P675) hybrid bearings and cal flaw models for Silicon lso, investigated advanced d conducted full-scale bearing	2.036	1.694	0.000	0.000	
<ul> <li>(U) In FY 2007: Develop a suite of advanced hybrid bearing technologies i growth and advanced VAATE turbine engines.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>						
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Pulse Detonation Engine (and Laser Induc Instrument).</li> </ul>		2.424	0.000	0.000	0.000	
<ul> <li>(U) In FY 2006: Worked to enhance capability to demonstrate detonation integrated test rig. Conducted test firings with multiple detonation initia attempting to provide technology risk reduction and alleviate detonation</li> </ul>	ation methods in parallel					
<ul> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>						
<ul> <li>(U) CONGRESSIONAL ADD: Research Institute for Environmental Studie</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Accelerate the development and demonstration of a module</li> </ul>	lar, portable wastewater	0.000	1.992	0.000	0.000	
<ul><li>treatment system that can meet EPA standards and can be deployed to f</li><li>(U) In FY 2008: Not Applicable.</li><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>	forward bases within 24 hours.					
(U) CONGRESSIONAL ADD: High Energy Laser for Detection Inspection	n and Non-Destructive Testing	0.000	2.690	0.000	0.000	
Project 3048	R-1 Line Item No. 8 Page-17 of 44			Exhibit R-2a (F	PE ()602203E)	

Exhibit R-2a, R	DT&E Project Justification		DATE	February 2007
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TIT 0602203F Aerosp		PROJECT NUMB 3048 Fuels ar	ER AND TITLE Id Lubrication
<ul> <li>U) B. Accomplishments/Planned Program (\$ in Millions)</li> <li>U) In FY 2006: Not Applicable.</li> <li>U) In FY 2007: Develop high-energy laser techniques for use of gas turbine engine components.</li> <li>U) In FY 2008: Not Applicable.</li> </ul>	as a non-destructive technique for inspection	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u> <u>FY 2009</u>
<ul><li>U) In FY 2009: Not Applicable.</li><li>U) Total Cost</li></ul>		20.723	24.599	17.349 26.08
<ul> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> FY 2006 FY 2007 <u>Actual Estimate</u> </li> <li>(U) Related Activities:         <ul> <li>(U) PE 0601102F, Defense Research Sciences.</li> <li>(U) PE 0602805F, Dual Use Science and Technology.</li> <li>(U) PE 0603216F, Aerospace Propulsion and Power Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul> </li> </ul>	FY 2008FY 2010EstimateEstimateEstimateEstimate	FY 2011 FY 20 Estimate Estim		Cost to Complete
Project 3048	R-1 Line Item No. 8 Page-18 of 44			Exhibit R-2a (PE 0602203)

Exhibit R-2a, RDT&E Project Justification										2007
BUDGET ACTIVITY 02 Applied Research				-	IBER AND TITL 03F Aerospa	.E ace Propulsi		ROJECT NUMBE <b>066 Turbine E</b>		nology
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3066 Turbine Engine Technology	33.107	42.568	51.506	83.546	76.501	46.558	40.753	3 41.676	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	) 0		

Note: The funding in this project has been increased to provide emphasis on adaptive cycle technologies, increased fuel efficiency, and highly efficient embedded turbine engines. Funds for the Fiscal Year 2006 Congressionally-directed Notre Dame Center for Flow Physics and Control in the amount of \$3.0 million were moved to PE 0601102F, Defense Research Sciences, from PE 0602203F, Aerospace Propulsion, for execution.

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

This project develops technology to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. Analytical and experimental areas of emphasis are fans and compressors, high temperature combustors, turbines, internal flow systems, controls, augmentor and exhaust systems, integrated power and thermal management systems, engine inlet integration, mechanical systems, and structural design. This project supports the Integrated Versatile Affordable Advanced Turbine Engine (VAATE) program, which is a joint DoD, NASA, and industry efforts to focus turbine propulsion technology on national needs. The program plan reflects the technology base support for VAATE activity applicable to global responsive strike, capable unmanned warfighting, tactical and global mobility, responsive space lift, and persistent Intelligence, Surveillance, and Reconnaissance. A portion of this project supports adaptive cycle technologies . This effort develops component technology for an adaptive cycle engine architecture that provides optimized performance/fuel efficiency for widely varying mission needs. A portion of the project supports the Energy Conservation - Assured Fuels Initiative. This effort identifies, develops and demonstrates technologies that enable the use of domestic fuel sources for military energy needs.

(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	MAJOR THRUST: Develop core turbofan/turbojet engine components (i.e., compressors, combustors,	16.200	17.700	33.664	60.113
	and high-pressure turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and				
	transports. Identify, develop and demonstrate technologies that enable the use of domestic fuel sources				
	for military energy needs. Develop advanced concepts, designs, design rules, and computational tools				
	to support component research and rig testing of components for an adaptive cycle engine. Develop				
	advanced concepts, designs, design rules, and computational tools to support research and rig testing of				
	component technologies to substantially improve specific fuel consumption by increasing overall				
	pressure ratio and turbine rotor inlet temperature; by improving component efficiencies; and by reducing				
	cooling air and pressure losses. Note: Increased funding in FY 2008 and out due to emphasis on				
	increased fuel efficiency, adaptive cycle technologies, and highly efficient embedded turbine engines.				
(U)	In FY 2006: Developed and applied advanced modeling and simulation rules and tools for advanced				
	components (high cycle fatigue, computational fluid dynamics, cycle analyses, propulsion system				
	models, component life models, probabilistic models, etc.). Incorporated advanced materials systems				
	into innovative designs (gamma titanium aluminides, metal matrix composites, ceramics, new metallic				
	alloys, etc.). Developed and extended analytical methods to predict integrally bladed rotor and airfoil				
	R-1 Line Item No. 8				
Pro	pject 3066 Page-19 of 44			Exhibit R-2a (F	PE 0602203F)
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	Exhibit R-2a, RDT&E Project Just	DAT	February 2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion		MBER AND TITLE The Engine Technology
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> durability, and damage tolerance. Conducted bench and rig tests of advanced compo- validation, including an advanced metal foam heat exchanger.	<u>FY 2006</u> nents for	<u>FY 2007</u>	<u>FY 2008</u> <u>FY 2009</u>
(U)	In FY 2007: Continue to develop and apply advanced modeling and simulation rules advanced components. Incorporate advanced materials into innovative designs and a Matrix Composite (CMC) turbine blades, turbine vanes, and turbine rear frame. Des tiled turbine airfoil technology to reduce cooling flow and increase life. Design and short, high efficiency afterburner concept. Conduct rig tests and design optimization durable, radiation barrier coatings to reduce the radiant heat loads on hot section corr fabricate, and rig test fan/radial compressor internal aerodynamics, large radius rotation profile annular combustor, and a large-scale casting of fan/radial compressor.	nalyze Ceramic ign and analyze demonstrate a very of effective, ponents. Design,		
(U)	In FY 2008: Continue to develop and apply advanced modeling and simulation rules advanced components. Develop and optimize novel dual fuel burner. Determine suit Titanium Aluminide materials for Mach 4 compressor application. Develop and app modeling and simulation rules and tools to significantly improve component efficien reduced fuel consumption in emerging and future gas turbine propulsion systems. D advanced modeling and simulation rules and tools to initiate definition and design of simple, adaptive cycle features. Develop and apply advanced modeling and simulation initiate definition and design of an efficient, wide-flow range compressor. Develop a modeling and simulation rules and tools to initiate definition and design of modeling and simulation rules and tools to initiate definition and design of modeling and simulation rules and tools to initiate definition and design of modeling and simulation rules and tools to initiate definition and design of modeling and simulation rules and tools to initiate definition and design of an efficien pressure ratio compressor and associated thermal management features that will offer improvement in engine SFC.	ability of latest ly advanced cies, enabling evelop and apply lightweight, on rules and tools to and apply advanced nt, very high		
(U)	In FY 2009: Continue to develop and apply advanced modeling and simulation rules advanced components. Conduct rig testing of advanced high pressure turbine vane a nano-laminate thermal barrier coating (TBC) applied. Begin to develop computationa methodology for analyzing turbine flows. Begin to develop CMC lifing models. Con tests for validation of components with significantly improved efficiency. Conduct r lightweight, simple, adaptive cycle features, an efficient, wide-flow range compresso temperature turbine capable of operating over large swings in required work, and an lightweight, LO-compatible exhaust system. Fabricate and rig test an efficient, very compressor and associated thermal management features that will offer a step change engine SFC.	nd blade al fluid dynamics aduct bench and rig ig testing of r, an efficient, high efficient, high pressure ratio		
(U)				
Pro		Item No. 8 20 of 44		Exhibit R-2a (PE 0602203F)

Exhibit R-2	DATE February 2007					
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITL 0602203F Aerospa			IBER AND TITLE		
<ul> <li><b>B. Accomplishments/Planned Program (\$ in Milli</b></li> <li>(U) MAJOR THRUST: Develop turbofan/turbojet engire engine controls, exhaust nozzles, and integration tech bombers, sustained supersonic strike and hypersonic</li> </ul>	ne components (i.e., fans, low pressure turbines, hnologies) for turbofan/turbojet engines for fighters,	<u>FY 2006</u> 10.311	<u>FY 2007</u> 11.000	<u>FY 2008</u> 12.486	<u>FY 2009</u> 16.524	
(U) In FY 2006: Developed and applied advanced mode components (high cycle fatigue, computational fluid models, component life models, probabilistic models innovative designs (gamma titanium aluminides, me alloys, etc.). Developed new and innovative design advanced components for validation.	eling and simulation rules and tools for advanced dynamics, cycle analyses, propulsion system s, etc.). Applied advanced materials systems to etal matrix composites, ceramics, advanced metallic					
(U) In FY 2007: Identify and quantify sources of variab durability performance (oxidation, creep, thermal ma advanced materials systems to innovative designs to and increase temperature capability of five centi-stol aeromechanics, and acoustic characteristics of a cour Conduct design optimization for turbine blade micro concepts in a single-flameholder rig to evaluate fund	aterial fatigue, high cycle fatigue, etc.). Apply determine wear reduction, improve load capacity, kes oil and to assess aerodynamics, operability, nter-rotating fan-on-blade (FLADE) concept. ocircuit cooling. Test pilot and fuel injection					
(U) In FY 2008: Continue to develop and apply advance advanced components. Conduct risk reduction testir rig test reheat augmentor technology to significantly advanced lightweight, variable area exhaust nozzle.	ng of variable bypass ratio fan concept. Develop and decrease burning length. Design and fabricate an					
(U) In FY 2009: Continue to develop and apply advance advanced components. Develop durable damping/er advanced fan design for application to a variable cyc	rosion coating systems. Conduct rig testing of					
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop limited life engine com applications, including long-range supersonic and hy with reduced cost, reduced fuel consumption, and in- the operating envelopes of missiles and unmanned view.</li> </ul>	ypersonic vehicles. These efforts enable engines creased specific thrust, thereby greatly expanding	3.278	3.530	3.969	5.188	
<ul> <li>(U) In FY 2006: Completed conceptual design of an adv and low-pressure component configurations for experimeet the small engine performance and cost reduction innovative designs and analyze a slinger-fed, dual-full</li> </ul>	vanced versatile and affordable high-pressure core endable engines using rub tolerant ceramic blades to on objectives. Applied advanced materials to					

Exhibit R-2a, RDT&E Project Justification					DATE February 2007			
		PE NUMBER AND TITLE 0602203F Aerospac			IUMBER AND TITLE bine Engine Technology			
	Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	eveloped and applied advanced modeling and simulation rules and tools for advar e., high cycle fatigue (HCF), computational fluid dynamics (CFD), cycle analyses	-						
	odels, component life models, probabilistic models, etc.). Completed detailed des							
	uid dynamics, and performed analyses for a fuel-cooled turbine. Developed new a							
	ncepts, and conducted bench and rig tests of advanced components for validation							
	FY 2007: Rig test a slinger-fed, dual-fuel CRC. Continue to develop and apply	_						
	Id simulation rules and tools for advanced components (i.e., high cycle fatigue, co namics, cycle analyses, propulsion system models, component life models, proba	-						
	g test a fuel-cooled turbine. Design and analyze a five-stage forward swept comp							
	FY 2008: Utilize data from high speed turbine engine testing of a wide-range, li							
	rbon-carbon variable area exhaust nozzle and a compact, carbon-carbon ramburn	er to update and						
	lidate advanced modeling and simulation rules and tools.							
	FY 2009: Utilize data from high speed turbine engine testing of a fuel cooled turing of a fuel CRC to update and validate advanced modeling and simulation							
(U)	inger-red, duar-ruer exe to update and vandate advanced modering and simulate	in fulles and tools.						
	AJOR THRUST: Develop components for turboshaft/turboprop and small turbo	an engines for	1.088	1.173	1.387	1.721		
	ainers, rotorcraft, special operations aircraft, and theater transports.							
	FY 2006: Developed and applied advanced modeling and simulation rules and to							
	pmponents (i.e., HCF, CFD, cycle analyses, propulsion system models, componen obabilistic models, etc.). Completed conceptual design of advanced versatile and							
-	gh-pressure core engine component configurations for turboshaft/turboprop engin							
	gine performance and cost reduction objectives. Applied advanced materials sys							
an	alyze a high heat release combustor. Developed new and innovative design conc							
	ench and rig tests of advanced components for validation.							
	FY 2007: Continue to develop and apply advanced modeling and simulation rule lvanced components. Apply advanced materials systems to innovative designs an							
	no-laminate thermal barrier coating. Develop new and innovative designs concep	•						
	In a finite design conception of a high heat release combustor design and an advanced							
ce	ntrifugal compressor design.	-						
	FY 2008: Develop new and innovative design concepts and conduct bench and n	ig tests for						
	lidation of a mixed flow turbine design.	anuard amont						
(U) In	FY 2009: Utilize data from efficient small scale engine testing of an advanced for	prwaru swept,						
Dualast		e Item No. 8						
Project		-22 of 44 180			Exhibit R-2a (F	1E 0602203F)		

	Exhibit R-2a, RDT&E Project Jus	DATE	DATE February 2007			
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602203F Aerospace P		IBER AND TITLE	hnology	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> centrifugal compressor and a silicon nitride mixed flow turbine to update and valida modeling and simulation rules and tools.	te advanced	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)						
(U)	CONGRESSIONAL ADD: VAATE TMC FLADE Technology Demonstration (for VAATE-Titanium Matrix Composites).	-	1.745	1.096	0.000	0.000
(U)	In FY 2006: Utilized previous Titanium Matrix Composites (TMC) modeling predidesign options for a TMC advanced fan blisk for application to a variable cycle engli					
(U)	In FY 2007: Continue development of Titanium Matrix Composites for advanced to components.	urbine engine				
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Intelligent Engine Software Development for Advanced	l Turbine Engines.	0.485	0.000	0.000	0.000
(U)	In FY 2006: Developed a generic, model-based reasoning software product that inc representation and implementation process, as well as the generic reasoning algorith traverse the model for ground-based troubleshooting and fault isolation applications modeling toll interfaces that allow the generic reasoning algorithms to work with did approaches and data structure, such as the DSI eXpress model that is currently used programs. Conducted research related to P-SAR and Multi-service implementations implemented an automated learning process and algorithm suite that will allow the f and maintenance task reasoners to improve over the life cycle of the product. Select specific engine model for use with the reasoning algorithms.	m suite that can Developed specific ferent modeling in various Air force Developed and ault/failure mode				
	In FY 2007: Not Applicable.					
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Active Combustion Control System for Military Aircraft	t.	0.000	3.885	0.000	0.000
(U)	In FY 2006: Not Applicable.					
(U)	In FY 2007: Develop advanced Active Combustion Control System (ACCS) compongoing and future engine development programs.	onents for use in				
	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
Pro		Item No. 8 23 of 44			Exhibit R-2a (F	PE 0602203F)

Exhibit R-2a, RDT&E Project Jus	stification		DATE	February	2007		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TI 0602203F Aeros			PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology			
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U)</li> </ul>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
<ul> <li>(U) CONGRESSIONAL ADD: Active Combustion Control Systems for Military Airc</li> <li>(U) In FY 2006: Not Applicable.</li> </ul>	eraft.	0.000	1.793	0.000	0.000		
(U) In FY 2007: Develop advanced active combustion control system components for	use in ongoing and						
<ul><li>future engine development programs.</li><li>(U) In FY 2008: Not Applicable.</li></ul>							
(U) In FY 2009: Not Applicable.							
<ul><li>(U)</li><li>(U) CONGRESSIONAL ADD: Advanced Affordability Assurance Tools for the Vers</li></ul>	atile Affordable	0.000	0.996	0.000	0.000		
Advanced Turbine Engine (VAATE) Initiative.							
<ul><li>(U) In FY 2006: Not Applicable.</li><li>(U) In FY 2007: Develop state-of-the-art computer software tools that will estimate de</li></ul>	velonment						
production, and maintenace costs for advanced technology turbine engines.	veropment,						
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
(U)	_						
(U) CONGRESSIONAL ADD: Intelligent Engine Technology Development for UAV	S.	0.000	1.395	0.000	0.000		
<ul><li>(U) In FY 2006: Not Applicable.</li><li>(U) In FY 2007: Develop turbine engine life management software to reduce overall e</li></ul>	ngine maintenance						
costs.	ingine maintenance						
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
(U) Total Cost		33.107	42.568	51.506	83.546		
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>							
	<u>2009</u> <u>FY 2010</u>		<u> </u>	Cost to	LOTAL COST		
(U) Related Materials: <u>Actual Estimate Es</u>	timate <u>Estimate</u>	<u>Estimate</u> E	stimate Estimate	<u>Complete</u>			
(U) PE 0601102F, Defense							
Research Sciences.							
(U) PE 0602102F, Materials.							
(U) PE 0603216F, Aerospace							
Propulsion and Power							
	ne Item No. 8 e-24 of 44			Exhibit R-2a (I	PE 0602203F)		
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BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
Technology. (U) PE 0602122N, Aircraft		
Technology.		
(U) PE 0603210N, Aircraft		
Propulsion.		
(U) PE 0603003A, Aviation		
Advanced Technology. (U) This project has been		
coordinated through the		
Reliance 21 process to		
harmonize efforts and		
eliminate duplication.		
(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.		
Not Applicable.		
	R-1 Line Item No. 8	
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					_			DATE			
	Exhibit R-	2a, RDT&I	E Project .	Justificatio	on				February 2	2007	
BUDGET ACTIVITY 02 Applied Research					IBER AND TITL 03F Aerospa	.∈ ace Propulsi	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology				
Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
3145 Aerospace Power Technology	45.414	44.595	30.784	31.125	35.072	34.205	33.314	34.066	Continuing	TBI	
Quantity of RDT&E Articles Note: Funds for the FY 2006 Congression	0	0	0	0	0	0	0	0			
<ul> <li>amount of \$1.0 million were moved to PE</li> <li>Congressionally-directed Advanced Energy</li> <li>From PE 0602602F, Conventional Munitic</li> <li><b>A. Mission Description and Budge</b></li> <li>This project develops electrical and t</li> <li>reliability, maintainability, commona</li> <li>power system technologies to enable</li> </ul>	0602601F, Spa y Technology f ns, for execution t <b>Item Justifica</b> hermal manage lity, affordabili	ce Technolog or Munitions n. tion ment technolo ty, and suppor	y, from PE 06 - Dominator F ogies for milita rtability of airc	02203F, Aero Program in the ary aerospace a craft and fligh	space Propuls amount of \$2 applications. t line equipme	ion, for execut .8 million wer Power comporent. Research	tion. Funds for e moved to Pl nent technolog is conducted i	or the FY 2006 E 0602203F, A gies are develo in energy stora	5 Aerospace Prop oped to increas age and hybrid	pulsion, e	
<ul> <li>weapon systems. This project support future aircraft platforms including str</li> <li>(U) <u>B. Accomplishments/Planned Prog</u></li> <li>(U) MAJOR THRUST: Develop electric</li> </ul>	ike and mobilit gram (\$ in Mill	y concepts. L <u>ions)</u>	ightweight po	ower systems s	uitable for oth	-	applications a			<u>FY 2009</u> 17.345	
technologies for manned and unman self-sufficiency, reliability, maintain enabling new capabilities. Develop conversion/storage, components and long endurance missions. Note: Inc development in support of electric h	ned aircraft sys ability, and sup hybrid electrica subsystem tech reased funding ybrid special pr	tems. These t portability, wl l power and th nologies for s in FY 2008 du ograms.	echnologies ir nile reducing l nermal manag pecial purpose ue to emphasis	nprove aircraf life cycle costs ement, includi e applications s on componer	t range, s and ng energy enabling nt						
(U) In FY 2006: Developed next general cells with high voltage battery catho breadboard of a high power fuel cell	des. Performed	system desig	n and analysis	-							
(U) In FY 2007: Fabricate and character Complete testing of an advanced sw thermal management studies and ide	itched reluctanc	e machine coi	ntroller. Comp								
(U) In FY 2008: Develop and design his components. Develop and test air very components. Design and fabricate the modeling & simulation, and develop endurance battery and fuel cell components.	chicle electroma nermal manager preliminary de	ignetic and rad nent compone signs for ener	lio frequency ents and subsy gy harvesting	effects immur stems. Initiate and energy de	ie e studies, nse, long						
Project 3145				Line Item No. 8 Page-26 of 44	3				Exhibit R-2a (Pl	E 0602203F)	
				184							

	Exhibit R-2a, RDT&E Project Jus	DATE	DATE February 2007			
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace	Propulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Techno		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> lightweight, energy dense, high power hybrid battery, fuel cell and power managem subsystems.	nent components and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	In FY 2009: Fabricate, integrate, and test high efficiency, high power, high temper components. Initiate integration and test air vehicle electromagnetic and radio freq immune components. Integrate and test thermal management components and subs and initiate subsystems test of flight-weight, efficient, energy harvesting, hybrid ba components.	uency effects systems. Integrate				
(U) (U)	MAJOR THRUST: Develop electrical power and thermal management, energy con- power conditioning components, and subsystem technologies for aerospace applica 2007, this activity will be completed.	•	4.146	3.997	0.000	0.000
(U)	In FY 2006: Completed testing a silicon carbide packaging concept for power elect development. Scaled-up sub-scale spray cooling flight tests to ten kilowatt (kW) ar modeling efforts to support the scale-up. Developed flight experiment for two-phase management system.	nd expanded				
	In FY 2007: Complete scale-up, modeling efforts and flight tests of ten kW spray of In FY 2008: Not Applicable.	cooling technology.				
	In FY 2009: Not Applicable.					
	MAJOR THRUST: Develop lightweight electrical power and thermal management subsystem technologies with low volume displacement to enable delivery of high p directed energy weapons.	-	14.020	14.638	14.253	13.780
(U)	In FY 2006: Developed conductor configuration, tested, and delivered a coil of altered tolerant high temperature superconducting material. Initiated preliminary design of (liquid) battery system for directed energy applications. Completed design of proof superconducting generator and began fabrication.	high rate lithium-ion				
(U)	In FY 2007: Continue design of high rate lithium-ion (liquid) battery system for di applications. Complete fabrication and begin testing proof-of-concept superconduction					
(U)	In FY 2008: Develop and initiate design of a flight-weight superconducting general charge/discharge energy storage and high voltage/current components and subsyste designs for superconducting multimegawatt generator.	tor, high rate				
(U)	In FY 2009: Complete design and fabrication of superconducting generator, energy	v storage and				
Proj		e Item No. 8 27 of 44			Exhibit R-2a (F	PE 0602203F)

	Exhibit R-2a, RDT&E Project Justification								
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602203F Aerospa		PROJECT NUMBER AND TITLE 3145 Aerospace Power Technol					
conditioning comp	nts/Planned Program (\$ in Millions) onents and subsystems.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U) In FY 2006: The i Li-ion batteries to	AL ADD: Cell-Level Battery Control. ndividual Application Specific Integrated Circuits and controlle form a new power supply for the Battlefield Air Operations (BA lso be applied to fighter aircraft or for Unmanned Aerial Vehicl	AO) kit. This	0.970	0.000	0.000	0.000			
<ul> <li>(U) In FY 2007: Not A</li> <li>(U) In FY 2008: Not A</li> <li>(U) In FY 2009: Not A</li> <li>(U)</li> </ul>	Applicable. Applicable.								
<ul> <li>(U) CONGRESSIONA</li> <li>(U) In FY 2006: Dever military platforms, military platforms</li> </ul>	L ADD: Center for Security of Large-Scale Systems. loped optimization strategies, prognostics, and health monitorin Applied Distributed Heterogeneous Optimization (DHO) and F with specific focus on near-space vehicles and more-electric po d used prototype hardware to validate DHO and PHM strategies	PHM to prospective wer-optimized aircraft.	1.358	0.000	0.000	0.000			
<ul> <li>(U) In FY 2008: Not A</li> <li>(U) In FY 2009: Not A</li> </ul>	Applicable.								
(U) In FY 2006: Developmentation with and demonstrated a Developed technolo minimized size/we technologies and d application, with a this 1-5 MW pulse thermal management technologies. Des	AL ADD: Integrated Power and Aircraft Technologies. loped and demonstrated an integrated power unit (IPU) as a much maximized power density (kW/ft3) and minimized logistics re- an engine-internal generator(s) for propulsion engines for an uni- ogies for superconducting generators of 1-5 Megawatt (MW) po- ight requirements for a generator and its cryocooling subsystem ynamic models of a 1-5 MW pulse-power generation system for conventional generator as the power source. Developed simula power system in an aircraft-installed configuration to identify e- ent requirements as well as benefits in utilizing recent thermal m- igned, built, and demonstrated various components supporting a re an external gearbox drive or its accessories. Applicable.	equirements. Designed manned aircraft. ower range with a. Developed r a directed energy tions and models of energy flow and management	5.139	0.000	0.000	0.000			
Project 3145		ne Item No. 8 je-28 of 44			Exhibit R-2a (I	PE 0602203F)			
						2 00022001 )			

Exhibit R-2a, RDT&E	Exhibit R-2a, RDT&E Project Justification						
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospac	e Propulsion	PROJECT NUM 3145 Aeros	2007 echnology			
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: High Flux ESC System with TES for N</li> <li>(U) In FY 2006: Developed spray cooling technology critical for coolin space and air vehicles. Evaluated scalability and reliability of the e management system. Scaled TMS to cool up to 30 kW of waste he 2 Megajoules. Designed and evaluated cooling system to operate in such as variable gravity and extreme temperatures.</li> </ul>	ng high heat flux tactical lasers on evaporative spray cooling thermal at with an energy storage capacity of	1.261	1.096	0.000	0.000		
<ul> <li>(U) In FY 2007: Continue development of evaporative spray cooling te tactical lasers.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>	chniques for cooling high heat flux						
<ul> <li>(U) CONGRESSIONAL ADD: Affordable Lightweight Power Supply</li> <li>(U) In FY 2006: Demonstrated a novel membrane electrode assembly a electrolyte and/or catalysts with vastly superior performance comparemperatures and low relative humidity. Further developed these camechanical integrity under harsh operating conditions. Constructed and short-stack fuel cells with enhanced performance that lead to in cost per kW of power and the utilization of high energy fuels.</li> </ul>	(MEA) employing advanced ared to conventional MEA's at high omponents to improve longevity and d and tested MEA's of various sizes	1.745	0.996	0.000	0.000		
<ul> <li>(U) In FY 2007: Continue to develop alternative high performance electron are capable of operating at high temperatures, zero or reduced humin system complexity and improved utilization of high energy fuels.</li> </ul>	•						
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>							
<ul> <li>(U) CONGRESSIONAL ADD: MEPS (Multimegawatt Electric Power</li> <li>(U) In FY 2006: Performed trade studies that investigate the possible the removal of heat from a high power microwave and the subseque airborne weapon/power system. Performed a sub-scale thermal ma removal technique. Developed a technique that prevents over-temp</li> </ul>	hermal management approaches to ent elimination of this heat from the nagement demonstration of the heat	1.358	1.295	0.000	0.000		
Project 3145	R-1 Line Item No. 8 Page-29 of 44			Exhibit R-2a (I	PF 0602203F)		

	Exhibit R-2a, RDT&E Project Jus	DATE	DATE February 2007			
BUDGET AC	CTIVITY ed Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUM 3145 Aeros			
micro (U) In FY (U) In FY	<b>Accomplishments/Planned Program (\$ in Millions)</b> rowave device in the event that the cooling technique ceases to function properly Y 2007: Continue the development of a multimegawatt electric power system. Y 2008: Not Applicable.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) CON	Y 2009: Not Applicable. NGRESSIONAL ADD: Chemical Hydride Power System (formerly Portable Po ploying Chemical Hydrides).	wer Solution 1.649	2.491	0.000	0.000	
Energ aspec rugge analy incre	Y 2006: Aided transition of the fuel cell power unit to the Battlefield Renewabl gy System (BRITES) through continued refinement of the energy storage cartricets of the cartridge performance were examined with respect to orientational dependences, and cost effectiveness. Multiple cartridges were constructed and evaluations of their performance and reliability was presented. Additionally, advanced easing cartridge energy density were explored. In particular, non-aqueous fuel h nined.	dge. Various bendence, ted and a detailed methodologies for				
chem	Y 2007: Further develop the technologies necessary to improve the reliability and nical hydride replacement cartridges for Airman portable power systems. Y 2008: Not Applicable.	nd compactness of				
(U) In FY (U)	Y 2009: Not Applicable.					
(U) In FY Addi	NGRESSIONAL ADD: Advanced Energy Technology for Munitions - Dominat Y 2006: Developed lightweight fuel cell stack materials to increase system pow itional goalsinclude development of lightweight recuperators, heat exchanges, a yers. Advanced fuel processing catalysts that are capable of logistic fuel operabilitied.	er density. nd cathode air	1.295	0.000	0.000	
for th	Y 2007: Continue development of a compact, flight weight solid oxide fuel cell he Area Dominator munition.	based power system				
	Y 2008: Not Applicable. Y 2009: Not Applicable.					
<ul><li>(U) CON</li><li>(U) In FY</li></ul>	NGRESSIONAL ADD: Integrated Electrical Starter/Generator Y 2006: Not Applicable. Y 2007: Develop technologies necessary to raise the technology readiness level	0.000 of integral	0.996	0.000	0.000	
	R-1 Line	Item No. 8				

		Exhibit	R-2a, RD1	C&E Proje	ct Justifica	tion			DATE				
-	GET ACTIVITY Applied Research		20, 10		PE N	PE NUMBER AND TITLE				February 2007           PROJECT NUMBER AND TITLE           3145 Aerospace Power Technology			
(U)	<b>B. Accomplishments/Planned P</b> starter/generators. Efforts will ind Inverter-Converter Controllers (I	clude a detaile		production-cor	nfiguration		<u>FY 2(</u>	006	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.												
(U) (U) (U)	CONGRESSIONAL ADD: Man In FY 2006: Not Applicable. In FY 2007: Develop the Superio VDC advanced military aircraft b Discharge.	or Lithium Pol	ymer Battery (	(SLPB) techno	blogy for a 5, 28	8 and 270	0.0	000	5.181	0.000	0.000		
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.												
	CONGRESSIONAL ADD: Mili In FY 2006: Not Applicable. In FY 2007: Develop high powe applications. Specific objectives modeling. In FY 2008: Not Applicable.		0.0	000	0.996	0.000	0.000						
(U) (U)	In FY 2009: Not Applicable. Total Cost						45.4	414	44.595	30.784	31.125		
(U)	C. Other Program Funding Sur	-											
(U) (U)	Related Activities: PE 0601102F, Defense Research Sciences. PE 0602102F, Aerospace Flight Dynamics. PE 0602605F, Directed	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete			
	Energy Technology. PE 0602805F, Dual Use				R-1 Line Item No								
Pro	ject 3145				Page-31 of 44 189	4				Exhibit R-2a (	~E U6U22U3F)		

BUDGET ACTIVITY       PE NUMBER AND TITL         02 Applied Research       0602203F Aerospa         (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Science and Technology.       (U)         (U)       PE 0603605F, Advanced	
Science and Technology. (U) PE 0603605F, Advanced	
<ul> <li>Weapon Technology.</li> <li>(U) PE 0603216F, Aerospace Propulsion and Power Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>	
(U) D. Acquisition Strategy Not Applicable.	
Project 3145 R-1 Line Item No. 8 Page-32 of 44 190	Exhibit R-2a (PE 0602203F)

		Exhibit R-	2a, RDT&I	E Project J	Justificatio	on			DATE	February 2	2007	
	T ACTIVITY plied Research									ECT NUMBER AND TITLE		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
33SP	Space Rocket Component Tech	0.000	58.085	46.819	45.915	48.989	49.192	48.478	49.494	0.000	0.000	
	Quantity of RDT&E Articles In FY 2007, efforts were transferred	0	0	0	0	0	0	0	0			
Cycle I (U) <u>A</u> T oi fu fu m oi gu fu to	<ul> <li>Propulsion Technology, absorbed the efforts of a thrust from Project 33SP, Space Rocket Component Technology, in order to more effectively manage cooperative Combined Cycle Engine (CCE) developments.</li> <li>(U) <u>A. Mission Description and Budget Item Justification</u> This project develops advances in rocket propulsion technologies for space access, space maneuver, tactical and ballistic missiles. Analytical and experimental areas of emphasis are propellants, propellant management, combustion, rocket material applications, Technology for Sustainment of Strategic Systems (TSSS) Phase 1, and novel space propulsion concepts. Technologies of interest will improve reliability, performance, survivability, affordability, and environmental compatibility of future space and missile launch subsystems. Technologies are developed to reduce the weight and cost of components using new materials and improved designs and manufacturing techniques. All efforts in this project contribute to the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program, a joint Department of Defense, NASA, and industry effort to focus rocket propulsion technology on national needs. This project also develops revolutionary, airbreathing, hypersonic propulsion technology options to enable affordable, on demand access to space for the Air Force. The short-term focus is on hydrocarbon fueled engines capable of operating over a broad range of Mach numbers and longer term focus will be on hydrogen fueled scramjet powered engines that can enable the higher Mach numbers to achieve access to space. Technologies developed under this program enable capabilities of interest to both the Department of Defense and the NASA. Efforts include modeling and simulation, proof of concept tests of critical components, advanced component development, and ground-based tests.</li> </ul>											
(U) <u>B</u> (U) M in id o p E a (U) In (U) In c	Accomplishments/Planned Progr [AJOR THRUST: Develop, charact agredients, and reduced-toxicity mon ew propellants synthesis methods. E ponic salt, high-energy-density oxidize f supporting computational tools; det ropellants; and for selected propellar fforts seek monopropellants with per ccess and space operations. Phases a n FY 2006: Not Applicable. n FY 2007: Further downselect and o andidates. Evaluate scaled-up and ne etermine materials compatibility and	ram (\$ in Mill erize, and test topropellants t Efforts include ers, nano-mate termining opti ths perform lab rformance equate referring to continue scalin ew selected pr	ions) advanced hyd o increase spa evaluation an rials, catalyst, mized paths fo ooratory and d ivalent to bip the IHPRPT ng-up promisin opellants in ac	rocarbons, end ce launch payl d development and polymeric or incorporatin emonstrator er opellants that program phase	ergetics, solid load capability t of reduced-to c binders; dev ng these materingine evaluation reduce the cost es. y-density mate ustion devices	propellant and refine oxicity elopment als into ons. st of space rials to	<u>FY 20</u> 0.0	<u>06 FY</u>	<u>Y 2007</u> 3.602	<u>FY 2008</u> 3.989	<u>FY 2009</u> 4.581	
Projec	t 33SP				Line Item No. 8 Page-33 of 44 191					Exhibit R-2a (P	E 0602203F)	

Exhibit R-2a, RDT&E Project Justification								
	PE NUMBER AND TITLE 0602203F Aerospace	PE NUMBER AND TITLE 0602203F Aerospace Propulsion			rle			
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
	ced performance and reliability							
velopment of potential hydrocarbor wnselect process and continue scal evelop new high engergy-density, butational code to predict molecula ants in advanced combustion devic de supporting large-scale motor tes	ing-up promising high high nitrogen ingredients. ar properties of propellant ces to determine materials							
evelopment of potential hydrocarb wnselect process and continue scal ontinue development and character ants in advanced combustion devic de supporting large-scale motor tes hase III goals. Initiate scale up of p	ing-up promising high rization of high nitrogen ces to determine materials sts. Continue exploration and promising ionic liquids for							
reliability needs for engine uses in advanced propulsion concepts wit	heavy lift space vehicles. th enhanced performance and	0.000	7.861	8.126	6.003			
vent damage to upper stage engines istion device technology, including rbon fuels capable of meeting or en indamental combustion and fluid flo nal management, scaling, and comb	s. Continue to develop, g injectors and chambers exceeding the Phase III goals. pw/heat transfer processes bustion instabilities in							
	m (\$ in Millions) ed propulsion concepts with enhan- ngines. velopment of potential hydrocarbo wnselect process and continue scal evelop new high engergy-density, putational code to predict molecula ants in advanced combustion devi- de supporting large-scale motor tes hase III goals. levelopment of potential hydrocart wnselect process and continue scal ontinue development and characte ants in advanced combustion devi- de supporting large-scale motor tes hase III goals. Initiate scale up of p of of concept for new computational liquid engine combustion technologies reliability needs for engine uses in advanced propulsion concepts wite ential launch systems. Phases are re- study, and evaluate shear coaxial it went damage to upper stage engine ustion device technology, including rbon fuels capable of meeting or en- damental combustion and fluid fle- nal management, scaling, and com	PE NUMBER AND TITLE 0602203F Aerospace m (\$ in Millions) ed propulsion concepts with enhanced performance and reliability ngines. velopment of potential hydrocarbon fuel additives to improve wnselect process and continue scaling-up promising high evelop new high engergy-density, high nitrogen ingredients. putational code to predict molecular properties of propellant ants in advanced combustion devices to determine materials de supporting large-scale motor tests. Continue exploration and	PE NUMBER AND TITLE 0602203F Aerospace Propulsion         m (5 in Millions)       FY 2006         ad propulsion concepts with enhanced performance and reliability ngines.       FY 2006         velopment of potential hydrocarbon fuel additives to improve wmselect process and continue scaling-up promising high evelop new high engergy-density, high nitrogen ingredients. putational code to predict molecular properties of propellant ants in advanced combustion devices to determine materials de supporting large-scale motor tests. Continue exploration and hase III goals.       Evelopment of potential hydrocarbon fuel additives to improve wmselect process and continue scaling-up promising high ontinue development and characterization of high nitrogen ants in advanced combustion devices to determine materials de supporting large-scale motor tests. Continue exploration and hase III goals. Initiate scale up of promising ionic liquids for of of concept for new computational code to predict molecular       0.000         liquid engine combustion technology for improved performance, advanced propulsion concepts with enhanced performance and antial launch systems. Phases are referring to the IHPRPT       0.000         study, and evaluate shear coaxial injector performance to ensure vent damage to upper stage engines. Continue to develop, istion device technology, including injectors and chambers rbon fuels capable of meeting or exceeding the Phase III goals. damental combustion and fluid flow/heat transfer processes and management, scaling, and combustion instabilities in es, reducing the need for conducting large numbers of costly	Anibit R-2a, RD1&E Project Justification         PROJECT NUM 33SP Space           m(\$in Millions)         FY 2006         FY 2007           ad propulsion concepts with enhanced performance and reliability ignes.         FY 2006         FY 2007           velopment of potential hydrocarbon fuel additives to improve waselect process and continue scaling-up promising high evelop new high engergy-density, high nitrogen ingredients.         FY 2006         FY 2007           variational code to predict molecular properties of propellant ants in advanced combustion devices to determine materials le supporting large-scale motor tests. Continue exploration and hase III goals.         Figure 1000         The figure 1000           levelopment of potential hydrocarbon fuel additives to improve wnselect process and continue scaling-up promising high ontinue development and characterization of high nitrogen ants in advanced combustion devices to determine materials le supporting large-scale motor tests. Continue exploration and hase III goals. Initiate scale up of promising ionic liquids for f of concept for new computational code to predict molecular         0.000         7.861           liquid engine combustion technology for improved performance, advanced propulsion concepts with enhanced performance and ential launch systems. Phases are referring to the IHPRPT         0.000         7.861           study, and evaluate shear coaxial injector performance to ensure rent damage to upper stage engines. Continue to develop, ustion device technology, including injectors and chambers rhon fuels capable of meeting or exceeding the Phase III goals. damenental combustion and fluid flow/heat transfer processes la manag	PENUMBER AND TITLE         PROJUCT STUDE           0602203F Aerospace Propulsion         PROJUCT NUMBER AND TITLE           33SP Space Rocket Complexity         Browner Stress           ad propulsion concepts with enhanced performance and reliability         Browner Stress           gines.         FY 2006         FY 2007         FY 2008           velop ment of potential hydrocarbon fuel additives to improve         waselect process and continue scaling-up promising high         evelop new high engregy-density, high nitrogen ingredients.           vulational code to predict molecular properties of propellant         and the set of pols.         Browner Stress           levelopment of potential hydrocarbon fuel additives to improve         wnselect process and continue scaling-up promising high         Browner Stress           ontinue development and characterization of high nitrogen         ants in advanced combustion devices to determine materials         Be supporting large-scale motor tests. Continue exploration and hase III goals.           levelopment for new computational code to predict molecular         0.000         7.861         8.126           reliability needs for engine uses in heavy lift space vehicles.         advanced propulsion concepts with enhanced performance, and enhalced performance and enhalced performance to ensure vent damage to upper stage engines. Continue to develop, stoin device technology, including injectors performance to ensure vent damage to upper stage engines. Continue to develop, stoin device technology, including injectors and ch			

	Exhibit R-2a, RDT&E Project Just	DATE February 2007				
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 33SP Space Rocket Component Tech			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> full-scale component and engine tests. Develop, scale-up, and transition new energe hydrocarbon fuels and additives for rocket propulsion, including space storable high fuels.		<u>FY 2007</u>	<u>FY 2008</u> <u>FY 2009</u>	?	
(U) (U)	In FY 2008: Characterize, study, and evaluate shear coaxial injector performance to chamber/injector compatibility and prevent damage to upper stage engines. Develop transition advanced combustion device technology, including injectors and chambers advanced synthetic hydrocarbon fuels capable of meeting or exceeding the Phase III improved understanding of fundamental combustion and fluid flow/heat transfer pro new methodologies for thermal management, scaling, and combustion instabilities in liquid rocket engines, reducing the need for conducting large numbers of costly full-and engine tests. Develop scale-up, and transition new energetic advanced hydrocar additives for rocket propulsion, including space storable high energy, non-toxic fuels validation and verification of advanced multi-phase modeling and simulation (M&S). Perform pre-selection of most promising advanced propulsion concepts; apply realist models to optimize performance. Continue and refine experimental demonstrations of continue development of realistic computational models. Continue system trade stud performance models to evaluate potential return on investment. In FY 2009: Characterize, study, and evaluate shear injector performance to ensure	b, analyze, and s suitable for goals. Develop cesses leading to a hydrocarbon fueled scale component bon fuels and s. Conduct ) capabilities. tic computational of proof-of-concepts, ies with improved chamber/injector				
	compatibility and prevent damage to engines. Develop, analyze, and transition adva device technology, including injectors and chambers capable of meeting or exceedin goals. Develop improved understanding of fundamental combustion and fluid flow// processes leading to new methodologies for thermal management, scaling, and comb in hydrocarbon fueled liquid rocket engines, reducing the need for conducting large f full-scale component and engine tests. Develop, scale-up, and transition new energe hydrocarbon fuels and additives for rocket propulsion, including space storable high fuels. Evaluate novel nozzle cooling channels for use with hydrocarbon fuels in the rig. Conduct validation and verification of advanced M&S capabilities. Perform pre promising advanced propulsion concepts; apply realistic computational models to op Continue and refine experimental demonstrations of proof-of-concepts, continue dev realistic computational models. Continue system trade studies with improved perform evaluate potential return on investment.	g the Phase III heat transfer pustion instabilities numbers of costly tic advanced energy, non-toxic high heat flux test -selection of most otimize performance. relopment of				
Pro		Item No. 8 35 of 44		Exhibit R-2a (PE 0602203P	F)	

Exhibit R-2a, RDT&E Project Justification DATE February								
BUDGET ACTIVITY 02 Applied Reseau	rch	PE NUMBER AND TITLE 0602203F Aerospace	Propulsion		IMBER AND TITLE e Rocket Component			
(U) <u>B. Accomplish</u> (U)	ments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) MAJOR THRU property enhance	JST: Develop advanced material applications for lightweight comp cements for use in advanced combustion devices and propulsion sy copulsion systems.		0.000	5.513	5.932	6.713		
<ul> <li>(U) In FY 2006: N</li> <li>(U) In FY 2007: Control to characterized and scale-up provide with high-ee</li> </ul>	- · ·	emperature polymers dvanced materials for						
(U) In FY 2008: Co to characterize and scale-up pr use with high-e components and	ontinue developing new advanced ablative components using hybr and finalize processing parameters of new nano-reinforced high ter rocessing of carbon-carbon materials. Continue developing new ad energy propellants. Continue to explore using nanocomposites for d optimize processing technology using multifunctional nanomater hobic and oleophobic materials.	emperature polymers dvanced materials for liquid rocket engine						
(U) In FY 2009: Co to characterize and scale-up pr use with high-e components and	ontinue developing new advanced ablative components using hybr and finalize processing parameters of new nano-reinforced high ter rocessing of carbon-carbon materials. Continue developing new ad energy propellants. Continue to explore using nanocomposites for d optimize processing technology using multifunctional nanomater d understand the mechanisms behind a new class of hydrophobic a	emperature polymers dvanced materials for liquid rocket engine rials. Continue to						
	JST: Develop advanced liquid engine technologies for improved p and reliability needs for engine uses in expendable and reusable lat		0.000	25.244	22.533	21.179		
(U) In FY 2007: Co liquid rocket up technologies - t	on the one of the one	genic upper stage ydrocarbon fuels and						
Project 33SP		ine Item No. 8 ige-36 of 44			Exhibit R-2a (F			

	Exhibit R-2a, RDT&E Project Just	DAT	DATE February 2007			
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion		PROJECT NUMBER AND TITLE 33SP Space Rocket Componen Tech		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> lightweight nozzles for liquid rocket engines. Start hydrocarbon boost technology de future spacelift concepts including materials scale-up efforts to improve life and weig engine components.	-	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Complete advance modeling and simulation tool development for advan liquid rocket upper stage technologies. Continue enabling hydrocarbon boost techno for future spacelift concepts. Initiate engine health monitoring effort supporting the l technology development effort. Also initiate Phase III efforts developing hydrocarbot technologies using fuels other than kerosene.	ogy development hydrocarbon boost				
(U) (U)	In FY 2009: Continue enabling hydrocarbon boost technology development for future concepts. Develop engine health monitoring technologies supporting the hydrocarbon development effort. Develop advanced hydrocarbon engine technologies using fuels kerosene that address Phase III goals.	n boost technology				
(U)	MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced pr technologies for stationkeeping, repositioning, and orbit transfer for large communica microsatellites, and satellite constellations. Phases are referring to the IHPRPT progr	tion satellites,	6.660	6.239	7.439	
(U) (U)	In FY 2006: Not Applicable.	ing Phase III e III evelopments for				
(U)	In FY 2008: Continue Hall thruster Phase III development efforts. Continue evaluat plasma thrusters for microsatellites propulsion systems. Continue scale-up testing Ph monopropellants. Continue assessment of advanced chemical propulsion technology satellite thrusters. Continue development of advanced multi-mode chemical-electric concepts for satellites. Initiate development of alternative propulsion concepts and as simulation, and analysis tools to augment or replace Hall Thrusters in the future.	ase II and III developments for propulsion				
(U)	In FY 2009: Continue Hall thruster Phase III development efforts. Continue evaluat plasma thrusters for microsatellites propulsion systems. Continue scale-up testing Ph monopropellants, evaluate advanced ingnition schemes and chamber concepts. Cont	ase II and III				
Pro	ject 33SP Page-3	tem No. 8 7 of 44 95		Exhibit R-2a (	PE 0602203F)	

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospa			MBER AND TITLE e Rocket Component		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> advanced chemical propulsion technology developments for satellite thrusters, begin developments. Continue development of advanced multi-mode chemical-electric pr for satellites, down-select to single design concept and begin component development development of alternative propulsion concepts and associated modeling, simulation to augment or replace Hall Thrusters in the future.	opulsion concepts nts. Initiate	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Conduct assessments, design trades, and simulations to integrat engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologie development of affordable, on-demand access to space vehicles to meet future warfi In FY 2008, this effort will transfer within this PE to Project 623012, Advanced Pro Technologies, to consolidate and better manage this cooperative CCE effort.	s in support of the ghter needs. Note:	0.000	0.239	0.000	0.000	
(U) (U) (U) (U)	In FY 2006: Not Applicable. In FY 2007: Conduct trade studies to determine military payoff and establish comp goals. Continue to define new component and engine performance objectives to ena affordable hypersonic CCEs. In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
<ul> <li>(U)</li> <li>(U)</li> <li>(U)</li> <li>(U)</li> <li>(U)</li> <li>(U)</li> <li>(U)</li> <li>(U)</li> <li>(U)</li> </ul>	CONGRESSIONAL ADD: Advanced Liquid Rocket Booster Technology. In FY 2006: Not Applicable. In FY 2007: Develop hydrocarbon boost rocket engine technologies for the Air For In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ce.	0.000	1.395	0.000	0.000	
	CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center. In FY 2006: Not Applicable. In FY 2007: Perform technical support and analysis for the Prompt Global Strike A Alternatives (AoA). Conduct facility upgrades to support upcoming testing which s efforts for Land-based Strategic Deterrent and Operationally Responsive Spacelift a In FY 2008: Not Applicable. In FY 2009: Not Applicable.	upport planning	0.000	3.188	0.000	0.000	
Prc		Item No. 8 38 of 44			Exhibit R-2a (F	PE 0602203F)	

Exhibit R-2a,	RDT&E Projec	t Justificat	tion			DATE Februar	v 2007	
BUDGET ACTIVITY 02 Applied Research			UMBER AND TI 2203F Aeros	TLE pace Propulsio		T NUMBER AND TITL		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions</u>	)			<u>FY 2000</u>	5 <u>FY 200</u>	<u>7 FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Engineering Tool Improver add was found in PE 0602500F, Multi-Disciplinary Space Component Technology. In FY 2007, this add was titled (ETIP) and transferred from PE 0602500F, Multi-Discip Propulsion Component Technology to better manage de</li> </ul>	ce Technology, Proje d Engineering Tool I linary Space Techno	ect 5026, Rocke mprovement P	et Propulsion rogram	0.000	) 2.78	9 0.000	0.000	
<ul> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Develop advanced rocket engine modeling and integrating them into seamless suite of tools for scie advanced propulsion technologies.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>		•						
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Methane Second Stage Roc</li> <li>(U) In FY 2006: Not Applicable.</li> </ul>	-			0.000	) 1.59	4 0.000	0.000	
<ul> <li>(U) In FY 2007: Develop liquid oxygen, liquid methane pre technologies for the Air Force.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	ssure fed second sta	ge rocket engir	le					
(U) Total Cost				0.000	58.08	5 46.819	45.915	
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2006</u> <u>FY 20</u> <u>Actual</u> <u>Estin</u>		FY 2009 Estimate	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>		<u>X 2013</u> Cost t Stimate Comple	- Total Cost	
<ul> <li>(U) Not Applicable.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable</li> </ul>								
Project 33SP		R-1 Line Item No Page-39 of 44 197	-			Exhibit R-2a	(PE 0602203F)	

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE		007
	ET ACTIVITY plied Research			-	PE NUM	BER AND TITL			OJECT NUMBE		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate		FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4847	Rocket Propulsion Technology Quantity of RDT&E Articles	35.244	18.985	10.719 0	9.081 0	11.758 0	11.871 0	12.122	12.430 0	Continuing	TBI
T e s c s t	A. Mission Description and Budget This project develops technologies for offorts) and tactical rockets. Technology ystems. Technologies are being acco components 25 percent (Phase I)/35 per urveillance efforts could reduce lifeti- his project are part of the Technology program.	the sustainme ogies of interes mplished in tw ercent (Phase) me prediction	ent of strategic st will improve vo phases and II) through the uncertainties	e reliability, pe are developed use of new m for individual	erformance, su l to reduce the naterials, and i motors by 50	rvivability, af weight by 15 mproving desi percent, enabl	ffordability, ar percent (Phas igns and manu ling motor rep	nd environment is I)/20 percent ifacturing tech lacement for o	ntal compatibil at (Phase II) an aniques. Agin cause (Phase II)	ity of these d cost of g and ). All efforts i	n
(U) <u>]</u> (U) 1 S	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop missile p systems. Efforts support the Technolo Note: Decreased funding in FY 2008 naturation and effort completions.	propulsion and ogy for the Su	l boost techno stainment of S	trategic Syste	ms program -	Phase II.	<u>FY 20</u> 10.2		<u>7 2007</u> 12.003	<u>FY 2008</u> 8.229	<u>FY 2009</u> 5.096
I S I C I I C U I I S S C I I I S S C I I I I S S I I S I S	In FY 2006: Enhanced component de missile technology demonstration. De strategic propellants for future ballisti ow-cost, high temperature, non-erosi components for solid rocket motors. I new fuels and oxidizers developed ov propulsion. Developed the modeling developing components for the TSSS actical propulsion technologies. In FY 2007: Initiate component devel Propulsion demonstration. Verify dev strategic propellants for future ballisti demonstrating low-cost, high tempera hybrid polymer components for solid propulsion technologies. Complete for using new fuels and oxidizers develop	eveloped rapic c missiles to e ve, lightweigh Formulated an er the last cou and simulation Phase II Miss lopment and r elopment of ra c missiles to e ture, non-eros rocket motors ormulation and	l densification nhance perfor t coated carbo d characterize ple of years fo n tool for solid ile Propulsion isk reduction e apid densificat nhance perfor ive, lightweigl . Continue de l characterizat	nozzle techno mance and we n-carbon cera d new propell r the next pha rocket motor Demonstratio	ology using im- eight. Demons- mic and hybri- ant formulation se of advanced s to be used in n. Developed Phase II Missi hnology using eight. Continue on-carbon, cer advanced taction	aproved strated d polymer ons using d solid advanced le g improved e ramic and ical ilations					
	ct 4847		1 ).	R-1	Line Item No. 8 Page-40 of 44					Exhibit R-2a (Pl	= 0602203E)

Exhibit R-2a, RDT&E Proje	Exhibit R-2a, RDT&E Project Justification										
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace	Propulsion		MBER AND TITLE							
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> solid propulsion. Conduct sub-scale tests to characterized and validate phy environments and incorporate into modeling and simulation tool developm be used in developing components for the Phase II Missile Propulsion Den	nents for solid rocket motors to	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>						
(U) In FY 2008: Continue component development and risk reduction efforts is Propulsion demonstration. Conduct sub-scale testing of rapid densification improved strategic propellants for future ballistic missiles to enhance perfor demonstrating low-cost, high temperature, non-erosive, lightweight coated hybrid polymer components for solid rocket motors. Complete modeling, development efforts. Continue development of advanced tactical propulsion	nozzle technology using prmance and weight. Continue carbon-carbon, ceramic and simulation, and analysis tool										
(U) In FY 2009: Continue component development and risk reduction efforts a Propulsion demonstration. Complete verification development of rapid der using improved strategic propellants for future ballistic missiles to enhance Continue demonstrating low-cost, high temperature, non-erosive, lightweig ceramic and hybrid polymer components for solid rocket motors. Down-se components, begin fabrication for sub-scale testing in FY 2010. Compone upcoming Missile Propulsion Demo for scale-up and demonstration. Cont advanced tactical propulsion technologies.	nsification nozzle technology e performance and weight. ght coated carbon-carbon, elect final sub-scale ents will then be feed into										
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop missile propulsion technologies and aging an for ballistic missile. Efforts support the Technology for the Sustainment of Phase II. Note: In FY 2007, this activity ramps up as it begins fabrication a demonstrator subsystems supporting future demonstrations across FY 2008</li> </ul>	f Strategic Systems program and testing of multiple	1.388	3.296	2.490	3.985						
<ul> <li>(U) In FY 2006: Completed analysis of existing sensor technologies for use in missile aging characteristics and status. Identified and evaluated existing a be embedded or attached to solid rocket motors. Developed the aging and tools necessary to translate and integrate sensor data into existing aging and</li> </ul>	assessment of ballistic and advanced sensors that can a surveillance models and										
(U) In FY 2007: Continue advanced service life prediction technology program existing and advanced sensors that can be embedded or attached to solid ro and surveillance models and tools that can translate and integrate the sensor surveillance tool suite.	m developing and applying ocket motors and the aging										
(U) In FY 2008: Continue advanced service life prediction technology program existing and advanced sensors that can be embedded or attached to solid ro											
Project 4847	R-1 Line Item No. 8 Page-41 of 44			Exhibit R-2a (F	PE 0602203F)						
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	Exhibit R-2a, RDT&E Project J	ustification		DATE	DATE February 2007			
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospac		MBER AND TITLE It Propulsion Technology				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> and surveillance models and tools that can translate and integrate the sensor data surveillance tool suite.	into existing aging and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Complete advanced service life prediction technology program dev existing and advanced sensors that can be embedded or attached to solid rocket r and surveillance models and tools that can translate and integrate the sensor data surveillance tool suite. Begin efforts to integrate advanced aging and surveillance demonstrations to validate and verify efforts to reduce uncertainties and accurate behavior.	notors and the aging into existing aging and e technologies into						
(U)			4 170	0.000	0.000	0.000		
(U) (U)	CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center (AVPC). In FY 2006: Performed technical support and analysis for the Prompt Global Str Alternatives (AoA). Conducted facility upgrades, which supported testing for pl Land-based Strategic Deterrent and Operationally Responsive Spacelift activities	anning efforts related to	4.170	0.000	0.000	0.000		
(U)	In FY 2007: Not Applicable.							
(U)	In FY 2008: Not Applicable.							
(U) (U)	In FY 2009: Not Applicable.							
(U)	CONGRESSIONAL ADD: Jet and Rocket Engine Test Site (JRETS) testing at International Airport.	San Bernardino	17.454	0.000	0.000	0.000		
(U)	In FY 2006: Upgraded JRETS test capabilities to a fully operational status in sup and commercial jet and rocket engine test programs.	pport of government						
(U)	In FY 2007: Not Applicable.							
(U)	In FY 2008: Not Applicable.							
(U)	In FY 2009: Not Applicable.							
(U)	CONCRESSIONAL ADD. II'L D D. (. II L. 'LD L ( E L		0.070	0.000	0.000	0.000		
(U) (U)	CONGRESSIONAL ADD: High Regression Rate Hybrid Rocket Fuels. In FY 2006: Conducted scale-up testing and technology maturation efforts for h	igh regression rate	0.970	0.000	0.000	0.000		
(0)	hybrid rocket fuels for use in space launch vehicles.							
(U)	In FY 2007: Not Applicable.							
(U)	In FY 2008: Not Applicable.							
(U)	In FY 2009: Not Applicable.							
(U)								
		Line Item No. 8						
Pro	ject 4847 Pa	age-42 of 44 200	l.		Exhibit R-2a (F	'E 0602203F)		

		Exhibit	: R-2a, RD1	C&E Projec	t Justifica	tion			DATE	February	2007
	BET ACTIVITY pplied Research					UMBER AND TI 2203F Aeros	TLE pace Propuls		ROJECT NUMBI 847 Rocket F	ER AND TITLE	
(U) (U)	<b>B. Accomplishments/Planned</b> CONGRESSIONAL ADD: Act In FY 2006: Obtained high spec purposes. In FY 2007: Upgrade/augment	rospace Lab Eq ed and visualiza	uipment Upgra ation tools for u	iniversity educ			<u>FY 2</u> 0.9	<u>006 I</u> 970	<u>EY 2007</u> 0.996	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U)	engineers. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	0	5			1					
(U) (U)	CONGRESSIONAL ADD: Ad In FY 2006: Not Applicable. In FY 2007: Develop small lau generate improved performance tanks as well as the engine desig cold-wall chamber as well as vo	nch vehicle size and/or operabi gns. Engine cor	e engines that u lity. Tasks inclusion to be example	tilize vortex co lude developm	ents in propella	ant storage	0.0	000	1.694	0.000	0.000
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable. CONGRESSIONAL ADD: Sol Systems. In FY 2006: Not Applicable.	id Boost Propu	lsion Technolo	gy for the Sust	ainment of Str	ategic	0.0	000	0.996	0.000	0.000
(U)	In FY 2007: Develop technolog In FY 2008: Not Applicable. In FY 2009: Not Applicable. Total Cost	gies that aid in t	he sustainment	of strategic so	lid rocket moto	ors.	35.2	244	18.985	10.719	9.081
(U)	<u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<mark>fillions)</mark> <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	Total Cost
(U) (U)	Related Activities: PE 0601102F, Defense Research Sciences. PE 0602114N, Power Projection Applied Research.										
	ect 4847				R-1 Line Item No	o. 8				Exhibit R-2a (F	

Exhibit R-2a, RDT&E Pro	pject Justification	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 4847 Rocket Propulsion Technology
<ul> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> <li>(U) PE 0602303A, Missile Technology.</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Tech.</li> <li>(U) PE 0603311F, Ballistic Missile Technology.</li> <li>(U) PE 0603401F, Advanced Spacecraft Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>	R-1 Line Item No. 8	
Project 4847	Page-44 of 44	Exhibit R-2a (PE 0602203F)

#### PE NUMBER: 0602204F PE TITLE: Aerospace Sensors

	Ex	hibit R-2,	RDT&E B	udget Item	n Justifica	tion			DATE	DATE February 2007		
	T ACTIVITY blied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors										
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
	Total Program Element (PE) Cost	114.934	133.235	108.055	103.739	112.113	113.144	110.852	113.264	Continuing	TBD	
2002	Electronic Component Technology	22.442	28.198	25.090	22.458	21.179	20.539	21.004	21.393	Continuing	TBD	
2003	EO Sensors & Countermeasures Tech	22.141	22.111	16.077	16.346	16.400	16.567	16.914	17.299	Continuing	TBD	
44SP	Space Sensors	0.000	8.848	10.244	8.948	10.556	10.477	10.541	10.775	Continuing	TBD	
4916	Electromagnetic Tech	17.746	21.252	12.513	11.808	11.625	12.178	12.449	12.751	Continuing	TBD	
6095	Sensor Fusion Technology	16.754	18.578	18.335	18.118	18.109	18.295	18.643	19.030	Continuing	TBD	
7622	RF Sensors & Countermeasures Tech	35.851	34.248	25.796	26.061	34.244	35.088	31.301	32.016	Continuing	TBD	

Note: In FY 2006, efforts in Project 5016 transferred to Project 2002 within this PE. Also in FY 2006, efforts in Project 5017 transferred to Project 7622 within this PE. In FY 2007, Project 44SP, Space Sensors, efforts will transfer from PE 0602500F, Multidisciplinary Space Technology, Project 5028, Space Sensors, Photonics and RF Processors, and Project 5029, Space Sensor and CM Technology, in order to more effectively manage and provide oversight of the efforts.

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

This program develops the technology base for Air Force aerospace sensors and electronic combat. Advances in aerospace sensors are required to increase combat effectiveness by providing "anytime, anywhere" surveillance, reconnaissance, precision targeting, and electronic warfare capabilities. To achieve this progress, this program pursues simultaneous advances in: 1) generating, controlling, receiving, and processing electronic and photonic signals for radio frequency (RF) sensor aerospace applications; 2) electro-optical (EO) aerospace sensor technologies for a variety of offensive and defensive uses; 3) RF antennas and associated electronics for airborne and space surveillance, together with active and passive electro-optical sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike RF sensors and electronic combat systems. Note: In FY2007, Congress added \$1.4 million for 3-D Packaging Technology for High Speed RF Communications; \$1.0 million for Phased Array Antenna Control Computer; \$1.6 million for the Center for Advanced Sensor and Communication Antennas; \$1.7 million for the Super-Resolution Sensor System; \$2.0 million for Opticall Pumped Atomic Laser; \$1.0 million for Hanscom AFB Collaboration on Meta-Materials and Conformal Antenna Technologies; \$2.0 million for WBI LADAR Development and Demonstration; \$1.4 million for Wideband Digital Airborne Electronic Sensing Array; and \$1.0 million for Sensor Network Technology. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronic, and electronic combat technologies.

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Exhibit R-2, RDT&E E	Budget Item Justification		DATE February 2007		
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sens				
U) <b>B. Program Change Summary (\$ in Millions)</b>					
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
U) Previous President's Budget	115.689	117.553	105.531	109.491	
U) Current PBR/President's Budget	114.934	133.235	108.055	103.739	
U) Total Adjustments	-0.755				
U) Congressional Program Reductions		-0.012			
Congressional Rescissions	-0.006	-0.506			
Congressional Increases		16.200			
Reprogrammings	0.497				
SBIR/STTR Transfer	-1.246				
U) <u>Significant Program Changes:</u> Not Applicable.					
C. Performance Metrics					
Under Development.					
•					
	R-1 Line Item No. 9				
	Page-2 of 37 204		Exhibit R-2	2 (PE 0602204F	

	Applied Research       0602204F Aerospace Sensors       2002 Electronic Component       Component         Cost (\$ in Millions)       FY 2006       FY 2007       FY 2008       FY 2009       FY 2010       FY 2011       FY 2012       FY 2013       Cost to       Total         Electronic Component       Estimate       E												
BUDGET ACTIVITY 02 Applied Research								20	2002 Electronic Component				
	Cost (\$ in Millions)										Total		
2002	-										TBD		
		, , , , , , , , , , , , , , , , , , ,	ů	÷	-	ů	•	ş					
Note:	In FY 2006, efforts in Project 5016 t	ransferred to t	his project in o	order to more	effectively ma	inage and prov	vide oversight	of the efforts.					
e c h d e	echnologies developed under this pro- ingagement capabilities. The technol components; photonic components; hi high-speed analog-to-digital and digit lensity packaging and interconnect te electronic component technologies. This lissipation, higher reliability, and import on Air Force and other Department of	ogies develope gh-temperatur al-to-analog m chnologies. T 'he project aim roved perform	ed include: exp re electronics; ixed mode int his project also as to demonstr- nance. The de	ploratory devi signal control egrated circui o designs, dev ate significant vice and comp	ce concepts, so and distributi ts; reconfigura relops, fabrica tly improved r ponent technol	olid state pow on; signal pro- able electronic tes, and evalua nilitary sensor logy developm	er devices and cessing; multi- s; power distr- ates technique s of smaller si aents under thi	amplifiers; le function mor ibution; multi s for integrati ze, lower wei s project are i	ow noise and s nolithic integra -chip modules ng combinatio ght, lower cos nilitary unique	ignal control ated circuits; ; and high ns of these t, lower power e; they are bas	r		
	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop compact components for communications, Glo advanced aperture subsystems that su efficient wideband, multi-function ser exciter subsystem technologies that energy EW systems.	t, affordable, 1 bal Positionin pport affordab 1sors for radar	nulti-function g System, rada le and scalable , EW, and con	ar, EW, and IS e antenna arra nmunications.	SR sensors. D bys, as well as Develop rece	evelop enable eiver and	<u>FY 20</u> 5.4		<u>Y 2007</u> 8.466	<u>FY 2008</u> 6.962	<u>FY 2009</u> 7.566		
I	In FY 2006: Demonstrated low cost, Demonstrated an affordable, compact Germanium (SiGe) technology for mo	receiver-on-a	-chip by lever	aging advance	es in commerc								
(U) I I	In FY 2007: Develop scalable panel Design and demonstrate a distributed used in radar and EW sensors for ISR	demonstration receiver/excite	with multiple er architecture	panel commu for advanced	inication and r	•••							
(U) I r	In FY 2008: Develop integrated wide receiver/exciter architecture for future demonstration of distributed receiver/	eband multi-ch e multi-intellig	annel phased	array subarray r applications	. Complete	n radar and							
Proje	ct 2002				Line Item No. 9 Page-3 of 37 205	)				Exhibit R-2a (P	E 0602204F)		

	Exhibit R-2a, RDT&E Projec	t Justification		DATE	DATE February 2007			
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospac	e Sensors		IMBER AND TITLE			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> EW sensors.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Demonstrate integrated wideband subarray for future multi-inter- applications. Design and develop digital/receiver components to enable full capability per transmit/receive (T/R) site to enable future software controlled	digital receiver/exciter						
(U) (U)	MAJOR THRUST: Develop new microelectronic component technologies is communications to support ISR, precision strike and battlespace access capa material research and microelectronic fabrication techniques.		1.119	4.214	3.758	3.418		
(U)		n components for low loss						
(U)	assessment techniques. Develop high performance radio frequency (RF) circ	-						
(U)	flexible substrates using advanced semiconducting materials and devices. In FY 2008: Fabricate and perform lab testing to investigate physical and ch microcircuits under operating conditions to understand operating lifetime lim Continue development of electronics modeling and assessment techniques. transparent RF electronics.	niting changes in structure.						
(U)	•	Further refine electronics						
(U) (U)	MAJOR THRUST: Develop integration and assembly technologies for high phased array sensors. Design and model photonic component technologies for signal processing. Develop Electro-Optical (EO) devices for next generation	for RF distribution and	2.824	4.367	6.224	3.266		
(U)	In FY 2006: Designed and fabricated advanced components for external and optical sources with high efficiency for RF photonic links used in radar and Demonstrated optical modulation technology with high linearity and dynamic access, and time-sensitive targeting capabilities.	l direct modulation of communications.						
(U)	In FY 2007: Design and develop RF modulation components to enable low arbitrary EO waveform generation. Initiate development of veritcal, externa lasers (VECSEL) as compact, efficient, high-nrightness sources. Initiate dev	l cavity, surface emitting						
		R-1 Line Item No. 9						

Exhibit R-2a, RDT&E Project Justification DATE February 2007								
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602204F Aerospace Sensors		PROJECT NUMBER AND TITLE 2002 Electronic Component Technology				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	optical components for high power mid-infrared (IR) applications. In FY 2008: Demonstrate photonic RF modulation components for RF links and arb generation. Continue development of VECSELs as compact, efficient, high-brightner Continue development of fiber optics and optical components for high power mid-IR	ess sources. applications.						
(U)	In FY 2009: Further develop VECSELs as compact, efficient, high-brightness source development of fiber optics and optical components for high power mid-IR application of the second sec	-						
(U)								
(U)	MAJOR THRUST: Develop signal control and low-power consumption component reduce both power loss and power consumption for future radar, electronic warfare, a Develop and integrate adaptable circuit technologies which utilize dynamic elements control for multi-function radar and EW sensors used for ISR and battlespace access Develop wideband (multi-octave) component technologies for multi-function RF ape and EW sensor systems.	and ISR sensors. and low loss signal capabilities.	6.463	5.262	5.924	5.968		
(U)	In FY 2006: Designed, implemented, and characterized low insertion loss tunable fi RF multifunction front ends. Demonstrated RF transistors with five-fold reduction is capacitance for equivalent power output. Designed and demonstrated Gallium Nitric field-effect devices with enhanced power handling capabilities.	n parasitic						
(U)	In FY 2007: Develop and demonstrate adaptable microcircuits for multi-function ap Characterize and transition reliable wideband power amplifiers for multifunction rad applications. Complete characterization of high reliability GaN based circuits for m Q-band applications.	ar and EW sensor						
	In FY 2008: Develop and demonstrate adaptable microcircuits for multi-function se In FY 2009: Develop tunable and reconfigurable wideband amplifiers for use in mu and EW sensors.							
(U)								
(U)	MAJOR THRUST: Refine materials and processes for two-dimensional and three-d interconnects and component protection from the environment. Develop and demon component technology that lowers system cost through reduction of design costs, par production costs, and integration costs.	strate innovative RF	0.968	2.207	1.119	1.122		
(U)	In FY 2006: Developed advanced component characterization techniques to assess a in emerging semiconductor technologies and to develop predictive failure models.	nd mitigate failures						
	in emerging semiconductor technologies and to develop predictive failure models.							
Pro		Item No. 9 5 of 37			Exhibit R-2a (	PE 0602204F)		
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Exhibit R-2a, RDT&E Project Justification February 2007							
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602204F Aerospace Sensors		PROJECT NUMBER AND TITLE 2002 Electronic Component Technology			
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Design and implement military specific RF components using advance techniques and latest commercial foundry advances. Characterize and perform trace respect to traditional RF component technologies.	-					
(U)	In FY 2008: Investigate microcircuit integration modeling and simulation tools to two-dimensional and three-dimensional electronics.	enable					
(U)	In FY 2009: Develop and demonstrate highly integrated phase control components multi-function sensors.	for use in wideband					
(U)							
(U)	MAJOR THRUST: Evaluate the integrated tool suite in the modeling, simulation, characterization environment for mixed-signal (digital, RF, microwave, etc.) composite advanced and emerging electronic component technologies.	•	3.710	2.287	1.103	1.118	
(U)	In FY 2006: Modeled and transitioned electrostatic adaptable microsystems for de environments.	nse signal					
(U)	In FY 2007: Design and initial modeling of next generation wideband gap devices temperature, and broadband multi-function systems.	for high power, high					
(U)	In FY 2008: Continue design and refinement of models for next generation high-p operate under extreme conditions and enable multi-function sensors.	ower components that					
(U)	In FY 2009: Demonstrate models and designs through the characterization of high for use in extreme environments with wideband and multi-function capability.	-power components					
(U)							
	CONGRESSIONAL ADD: 3-D Packaging Technology for High Speed RF Comm		1.950	1.395	0.000	0.000	
	In FY 2006: Conducted Congressionally-directed effort for 3-D Packaging Techno RF Communications.						
(U)	In FY 2007: Conduct Congressionally-directed effort for 3-D Packaging Technology	ogy for High Speed					
(T. 1)	RF Communications.						
	In FY 2008: Not Applicable.						
	In FY 2009: Not Applicable. Total Cost		22.442	20 100	25.090	22 150	
(0)			22.442	28.198	23.090	22.458	
Proi		e Item No. 9 e-6 of 37			Exhibit R-2a (	PE 0602204E)	

	Exhibit	: R-2a, RD	ſ&E Projec	t Justifica	ition				February 2007
BUDGET ACTIVITY 02 Applied Research				0602204F Aerospace Sensors 2002				PROJECT NUMBE 2002 Electroni Technology	
(U) <u>C. Other Program Funding Sur</u>	<u>nmary (\$ in N</u>	<u>(fillions)</u>							
	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	FY 2011 Estimate	FY 2012 Estimate		Cost to Complete Total Cost
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li> <li>(U) PE 0603203F, Advanced Aerospace Sensors.</li> <li>(U) PE 0603270F, Electronic Combat Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	e <u>Estimate</u>	Complete
Project 2002				R-1 Line Item N Page-7 of 3					Exhibit R-2a (PE 0602204F)
				209					

	Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
BUDGET ACTIVITY 02 Applied Research					1BER AND TITL 04F Aerospa	E ace Sensors	03 EO Sens	JECT NUMBER AND TITLE 3 EO Sensors & Intermeasures Tech		
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2003 EO Sensors & Countermeasures Tech	22.141	22.111	16.077	16.346	16.400	16.567	16.914	17.299	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
This project determines the technical sensor technologies under development integration, digital processing, analy tracking, and identification of non- hyperspectral imaging sensors and and targeting. Other project goals in	nent range from the second sec	he ultraviolet nsor architectu lifficult targets d to enable pro	through the ir ires. One of t s, such as those ecision targeti	nfrared (IR) po the project's ma se obscured by ing in severe w	ortion of the sp ain goals is to camouflage.	bectrum. Rela improve EO a This project a	ted efforts inc and related tec ilso develops t	lude improver chnologies for the passive and	nents in avion the detection, d active	
(U) <b><u>B. Accomplishments/Planned Pro</u></b>	ogram (\$ in Mill	<u>ions)</u>				<u>FY 20</u>	<u>06 F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop techn	ology for non-co	operative dete	ction and ide	ntification of a	irborne	1.8	62	2.795	2.858	2.978
<ul> <li>and ground-based targets.</li> <li>(U) In FY 2006: Expanded ground- an identification (CID) systems with r combat identification sensors to incelectronics capable of simultaneous for layered sensing based on multip</li> <li>(U) In FY 2007: Perform off-board cue systems with multi-spectral, polariz combat identification including 3-I focal planes and read-out electronic demonstration of EO/IR system arc deep penetration and continuous ar</li> <li>(U) In FY 2008: Perform phenomenolog perform sensor concept modeling. using passive multispectral/polarim longwave hyperspectral sensor for focal planes and read-out electronic</li> </ul>	nulti-spectral, po elude 3-D imagin s multi-discrimin ole platform type d ground- and ai cation-based targ D imaging and vil es capable of sim hitectures for lay ea coverage. ogy experiments Collect signature performing ident	larization-base g. Developed ant sensing. C s for deep pene r-based testing et re-acquisition bration sensing ultaneous mul vered sensing b for multi-discre- e data for targe hniques. Char ification of ga	ed detection a hybrid focal p Completed EC etration and c g and demonst on and active g. Continue de ti-discriminar pased on mult criminant active et discriminati racterize the p seous targets.	nd cueing and planes and reac O/IR system are ontinuous area tration of adva EO interrogati evelopment of nt sensing. Be tiple platform t re/passive sens ion and shape of performance of Demonstrate	active EO I-out chitectures a coverage. nced CID on for hybrid gin ypes for ing and extraction a hybrid					
develop image processing techniqu	es for sensor dat	a enhancemen	t.							
Project 2003				l Line Item No. 9 Page-8 of 37	)				Exhibit R-2a (P	

	Exhibit R-2a, RDT&E Proje	ect Justification	DATE	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospac	e Sensors	2003 EO Se	IBER AND TITLE nsors & asures Tech	
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2009: Perform sensor concept demonstrations for multi-discrimination quantify expected system performance. Characterize target discrimination performance using passive multispectral/polarimetric sensing techniques. hybrid focal planes and read-out electronics for simultaneous multi-discrim and refine image processing techniques for sensor data enhancement. Perf range target identification using passive and active techniques, including p synthetic aperture laser radar.	and shape extraction Continue demonstration of ninant active/passive sensing, form trade-off studies for long	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop optical transmitter technology capable of sen characteristics for robust non-cooperative target identification. In FY 2006: Tested optical transmitter technologies capable of sensing mu robust non-cooperative target identification. Developed adaptable wavefor sensing. Conducted laboratory and field tests and utility analysis of multi- vibration/imaging sensing system and evaluated performance for long rang flights for pulsed gated imager and vibration CID sensor. Tested breadboat transmitter and evaluated performance for both hard and extended targets. long-range, multi-function brassboard sensor development. Utilized flight testing of long-range air-to-air and air-to-ground systems under development passive and multi-function active sensing phenomenology data in airborne target detection analysis including diverse background characterization. In FY 2007: Continue development and testing of optical transmitter techn capable of sensing multiple target characteristics for robust non-cooperativ Continue laboratory and field tests and utility analysis of multi-function pu sensing system and evaluate performance for long-range CID. Perform flig gated imager and vibration CID sensor. Complete testing of breadboard ac and evaluate performance for both hard and extended targets. Continue flight multi-function engineering model sensor development. Utilize flight test p long-range air-to-air and air-to-ground systems under development. Continue passive and multifunction active sensing phenomenology data in airborne of target detection analysis including diverse background characterization. In FY 2008: Extend development and testing of optical transmitter techno	altiple target characteristics for rms for multi-discriminant function pulsed ge CID. Performed initial rd active multi-spectral Conducted flight capable, test platform to support ent. Collected simultaneous environment for difficult hologies including waveforms e target identification. Ilsed vibration/imaging ght data collections for pulsed ctive multi-spectral transmitter ght capable, long-range, platform to support testing of nue collection of simultaneous environment for difficult	3.051	7.384	5.973	6.561
. /		R-1 Line Item No. 9				

	Exhibit R-2a, RDT&E Project Just	tification		DATI	E February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospac	e Sensors	2003 EO Se	MBER AND TITLE Insors & asures Tech	
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> target identification to increased standoff ranges. Explore optical discriminants for l identification including shape, polarization, and vibration using real-beam and synth techniques. Develop advanced models to support phenomenology-driven sensor trace active and passive sensors. Perform tower and flight collections to validate system r Explore enabling sensor components to support extended range operation. In FY 2009: Continue development and testing of optical transmitter technologies for target identification at long standoff ranges. Perform multi-function signature collecc identification including shape, polarization, and vibration using real-beam and synth techniques. Develop optimal system concepts using advanced active and passive ser Continue tower and flight collections to quantify expected performance. Develop er	etic aperture sensing le studies with both nodeling results. r non-cooperative tions for long range etic aperture sensing nsor models.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	components for a long range demonstration system.					
(U) (U)	MAJOR THRUST: Develop innovative techniques and components to target difficul battlefield environments. In FY 2006: Developed techniques and components to target difficult objects in deg conditions. Integrated and evaluated weather/obscurant penetration concepts. Evalue non-mechanical beam steering concepts for advanced multi-mode sensor application precision pointing, focusing, and wavefront correction and extended to common EO/ (RF) aperture implementation. Developed and demonstrated combined EO/RF apert preliminary sensor configuration. Continued tests, analysis, and evaluation of specia laser radar (LADAR) for detection and characterization of difficult targets. Comple architecture definition for advanced EO unmanned aerial vehicle (UAV) based syste identify difficult targets in difficult environments including the urban environment. I advanced passive and multi-function active sensing methods to exploit all salient tar- phenomenologies. Performed target phenomenology investigations. In FY 2007: Continue development and begin demonstration of techniques and com difficult objects in degraded atmospheric conditions. Integrate and evaluate weather penetration concepts into system level tests. Demonstrate utility of non-mechanical advanced multi-mode sensor applications, including precision pointing, focusing, an correction. Continue development and demonstrations of combined EO/RF apertures preliminary sensor configuration. Continue analysis and evaluation of specialized multi-	raded atmospheric lated utility of s including fradio frequency ure including lized multi-function ted optimized ms to find, fix, and incorporated get and background ponents to target /obscurant beam steering for d wavefront s including	4.782	3.561	3.660	3.807
	pject 2003 R-1 Line Page-	Item No. 9			Exhibit R-2a (I	

	Exhibit R-2a, RDT&E Project Jus	tification		DAT	DATE February 2007		
	GET ACTIVITY Applied Research	ce Sensors	2003 EO Se	MBER AND TITLE Insors & asures Tech			
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	LADAR for detection and characterization of difficult targets. Explore implementa architectures for advanced EO UAV-based systems to find, fix, and identify difficult						
	challenging environments including the urban environment. Incorporate advanced p						
	multifunction active sensing methods to exploit all salient target and background pho						
	Continue target phenomenology investigations.						
(U)	In FY 2008: Extend development of techniques for targeting difficult objects in dyn						
	environments. Develop passive infrared components and techniques for continuous broad areas with detection/tracking of dynamic targets and events. Continue develo						
	non-mechanical beamsteering for both passive and active sensors. Explore passive a	-					
	sensing phenomenology techniques for capturing robust spectral, spatial, polarimetri						
	signatures for moving target identification and track association in dense target areas						
(U)	In FY 2009: Continue development of techniques for targeting difficult objects in d environments. Perform concept demonstrations of passive infrared continuous survey	-					
	areas with detection/tracking of dynamic targets and events. Develop sensor concept						
	optimizing revisit rate and perform design trade-off experiments. Perform spectral,	-					
	and radiometric signature collection experiments using laboratory passive and active	e LADAR sensors					
( <b>T T</b> )	for moving target identification and track association in dense target areas.						
(U) (U)	MAJOR THRUST: Develop countermeasure technologies for use against IR- and E	O guidad missila	2.442	1.995	2.919	2.246	
(0)	threats.	o-guided missile	2.442	1.995	2.919	2.240	
(U)	In FY 2006: Evaluated countermeasure techniques to defeat first generation IR image	ging missile seekers.					
	Conducted the exploitation of advanced IR missiles and IR sensor technology for co						
	technique updates and refinement. Developed active sensing technology to defeat m	ulti-band IR					
(U)	sensors. In FY 2007: Complete evaluation of countermeasure techniques to defeat first gene	ration IR imaging					
(0)	missile seekers. Initiate development of second generation IR imaging missile seeker						
	models/simulations for countermeasure technique development. Continue exploitati						
	missiles and IR acquisition sensors for countermeasure technique updates and refine						
	laboratory assessments of active sensing technology to evaluate capabilities against	multi-band IR					
(U)	sensors. In FY 2008: Continue development of second generation IR imaging missile seeker	models/simulations					
		Item No. 9					
Pro		11 of 37 2 <b>13</b>			Exhibit R-2a (	PE 0602204F)	

	Exhibit R-2a, RDT&E Project Just	ification		DAT	DATE February 2007		
	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602204F Aerospace	Sensors	2003 EO Se	MBER AND TITLE Insors & asures Tech		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> for countermeasure technique development. Continue exploitation of advanced IR n acquisition sensors for countermeasure technique updates and refinement. Initiate id discriminants for specific identification of new EO sensors and missile threats.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	In FY 2009: Evaluate countermeasures techniques to defeat second generation IR in seekers. Develop new countermeasure technique updates and refinement applicable Continue identification of discriminants for specific identification of new EO sensor.	to legacy systems.					
(U)		. 1	1 7 1 5	0.000	0.667	0.754	
(U)	MAJOR THRUST: Develop aerospace missile and laser warning technologies to ac countermeasures.	curately cue	1.715	0.698	0.667	0.754	
	In FY 2006: Completed developing a laser threat scenario testbed for sensor technol Developed new laser warning sensor technologies to address ultra-short and tunable Developed advanced laser warning concepts for aircraft, to include integration into U vision goggles (NVG).	laser threats. JAVs and night					
(U)	In FY 2007: Continue developing laser warning sensor concepts for UAVs and NVG developing new laser warning sensor technologies to address ultra-short and tunable Initiate development of an advanced laser warning concept for integration into tactic	laser threats.					
(U)	In FY 2008: Continue developing new laser warning sensor technologies to address tunable laser threats. Identify methods to increase focal plane array dynamic range f characterization of low power and high power laser threats.	ultra-short and					
(U)	In FY 2009: Continue developing new laser warning sensor technologies to address tunable laser threats. Identify clutter suppression techniques to increase signal to not detection ranges in urban operations. Evaluate algorithms to optimize detection/decl	se and improve					
(U)							
(U)	CONGRESSIONAL ADD: Watchkeeper.		4.096	0.000	0.000	0.000	
(U) (U)	In FY 2006: Conducted Congressionally-directed effort for Watchkeeper. In FY 2007: Not Applicable.						
(U)	In FY 2008: Not Applicable.						
` '	In FY 2009: Not Applicable.						
(U)							
(U)	CONGRESSIONAL ADD: Super-Resolution Sensor System.		3.218	1.694	0.000	0.000	
(U)	In FY 2006: Conducted Congressionally-directed effort for the Super-Resolution Se	nsor System.					
Pro		Item No. 9 12 of 37			Exhibit R-2a (I	PE 0602204F)	

Exhibit R-2a, RDT&E Project Ju	stification		DATE	February	2007	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND T 0602204F Aeros		2003 EO Se	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		FY 2006	<u>FY 2007</u>	FY 2008	<u>FY 2009</u>	
<ul> <li>(U) In FY 2007: Conduct Congressionally-directed effort for the Super-Resolution Set</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	nsor System.					
<ul> <li>(U)</li> <li>(U) CONGRESSSIONAL ADD: Optically Pumped Atomic Laser (OPAL).</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for OPAL.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for OPAL.</li> </ul>		0.975	1.992	0.000	0.000	
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>		0.000	1.000	0.000	0.000	
<ul> <li>(U) CONGRESSIONAL ADD: WBI LADAR Development and Demonstration</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for WBI LADAR Developm Demonstration.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	nent and	0.000	1.992	0.000	0.000	
(U) Total Cost		22.141	22.111	16.077	16.346	
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>						
	2009FY 2010timateEstimate	FY 2011FY 201EstimateEstimate			Total Cost	
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li> </ul>				-		
(U) PE 0603253F, Advanced Sensor Integration.						
(U) PE 0602301E, Intelligence System Program.						
<ul> <li>(U) This project has been coordinated through the Reliance 21 process to</li> </ul>						
	ne Item No. 9 e-13 of 37			Exhibit R-2a (F	PE 0602204F)	

Exhibit R-2a, RDT&E I	Project Justification	DATE February 2007
UDGET ACTIVITY 2 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2003 EO Sensors & Countermeasures Tech
J) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
harmonize efforts and eliminate duplication.		
J) <b>D. Acquisition Strategy</b> Not Applicable.		
Not Applicable.		
Project 2003	R-1 Line Item No. 9 Page-14 of 37	Exhibit R-2a (PE 060220

									DATE		
		Exhibit R-	2a, RDT&I	E Project	Justificatio	on				February 2	2007
	ET ACTIVITY I <b>plied Research</b>					IBER AND TITL	.E ace Sensors		OJECT NUMBE SP Space S	R AND TITLE	
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
44SP	Space Sensors	0.000	8.848	10.244	8.948	10.556	10.477	10.541	10.775	Continuing	TB
	Quantity of RDT&E Articles	0	0	0		0		0		1	. 5020
	In FY 2007, efforts will transfer from Sensor and CM Technology, to this p					-	-	, Photonics, a	nd RF Process	sors and Proje	et 5029,
(1 e sj a sj	This project focuses on developing me mixed) signals for radio frequency (R lectronic warfare, and precision enga- pace sensor information fusion for tir nd evaluates innovative electromagne pace sensors of smaller size, lower we ssesses multi-dimensional adaptive te	F) space sense gement sensor nely and comp etic and electro eight, lower co	or applications s based in spa orehensive cor onic counterm ost, lower pow	s. The enablir ce. This proje nmunications easures for sp ver dissipation	ng technologie ect develops th and situationa ace application , higher reliab	s will be used ne baseline tec I awareness. ns. This proje ility, and imp	for intelligent chnologies requ Through mode ect aims to den roved performa	ce, surveillanc uired to mana eling and simu nonstrate sign ance. This pr	e, reconnaissa ge and perforr ilation, this pr ificantly impro oject also devo	nce (ISR), n on-board oject develops oved military	1
(U) N r a s s F	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop hybrid s risks. Investigate hardware and softw and of difficult targets from space. Do sensors capable of operating in jammi sensor-to-warfighter operations. Note previously performed under other maj emphasis.	pace-based se are implement evelop space-ong ng environme : In FY 2007,	nsor solutions tation approac qualified preci nts while enab space-based s	hes for the new sion time, poso bling multiple ensor platform	eds of respons sition, and velo platform n technology e	ive space ocity efforts,	<u>FY 20</u> 0.00		<u>7 2007</u> 3.970	<u>FY 2008</u> 3.161	<u>FY 2009</u> 4.092
	n FY 2006: Not Applicable.										
	n FY 2007: Initiate identification and	-	-	chniques and	technologies t	o further					
(U) I N t	expand the capabilities of space-based in FY 2008: Define responsive space Model size, weight, and power (SWaF echniques for space-based application space-based assured reference techniq	sensor function )-restricted properties of the p	onal capabilition ecision time, onstructive sy	position, and stems enginee	velocity sensor ering model to	r assess					
(U) I c s	In FY 2009: Experimentally assess fe concept. Design SWaP-restricted pre- space-based applications. Demonstrat assured reference techniques in terms	asibility of reaction time, po te constructive	sponsive "plug psition, and ve systems engi	g- n- play" sate locity sensor t neering mode	ellite impleme techniques for l to assess space	ntation					
Projec	ct 44SP				Line Item No. 9 Page-15 of 37 <b>217</b>	)				Exhibit R-2a (P	E 0602204F)

	Exhibit R-2a, RDT&E Project J	DATE	February	2007			
	ET ACTIVITY oplied Research	PE NUMBER AND TITLE 0602204F Aerospace		PROJECT NUM	IBER AND TITLE		
(U) <u>F</u> (U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) N r a n d	MAJOR THRUST: Develop advanced active phased array antenna subsystems trequirements of affordable space based sensing including the restrictions on mass advanced materials to demonstrate low-mass, low cost, reliable and scalable aper multi-band and multi-beamforming technologies. Address technologies for anter dynamic sensor networks. Supports ISR capability.	s, size, power. Utilize tures. Develop	0.000	2.215	3.199	0.954	
(U) I	In FY 2006: Not Applicable. In FY 2007: Demonstrate low-mass scalable tiles/panels with advanced thermal improved efficiency for active components.	management and					
	In FY 2008: Develop sub-array level digital beamforming and low-cost L-band	antenna panels.					
(U) I (U)	In FY 2009: Experimentally assess enhanced antenna signal interference comparation	ibility capability.					
c ti	MAJOR THRUST: Study adaptive processing techniques for large, multi-missic conformal arrays to meet the stringent demands of wide area coverage, target det tracking in severe clutter and interference environments.		0.000	1.733	1.819	1.859	
(U) I c	In FY 2006: Not Applicable. In FY 2007: Develop adaptive processing techniques suitable for implementatio computing architectures for multi-intelligence ISR sensing from space-based pla processing methods and novel adaptive transmit waveform techniques for a space	forms. Develop signal					
	In FY 2008: Evaluate adaptive transmit and receive techniques for surface movi (SMTI) from space under a variety of tactical scenarios and interference environments and interference environments.						
s	In FY 2009: Integrate developed algorithms, waveforms and space platform scensurveillance network of sensors.	narios into a					
i i	MAJOR THRUST: Develop advanced component technology for space-based so improving performance and reducing size, mass, and prime power. Investigate p issues associated with newer component technologies to ensure more rapid and a Supports ISR capability.	re-space qualification	0.000	0.930	0.752	0.679	
<ul> <li>(U) I</li> <li>(U) I</li> <li>(U) I</li> </ul>	In FY 2006: Not Applicable. In FY 2007: Develop and model an initial reduced power architecture for large a In FY 2008: Validate new low-cost RF sub-assembly technology compatibility f Evaluate plastic packaging, liquid crystal polymer packages, and RF-on-Flex boa	or space qualification.					
Projec		ine Item No. 9 age-16 of 37			Exhibit R-2a (I	PF 0602204F)	

		Exhibit	: R-2a, RD	F&E Projec	t Justificat	tion			DATE	February	2007
	UDGET ACTIVITYPE NUMBER AND TITLEPROJEC2 Applied Research0602204F Aerospace Sensors44SP S										2001
(U)	<b>B. Accomplishments/Planned</b> In FY 2009: Develop compact environments.			signal rejectio	n in dense sign	al	<u>FY 2</u>	<u>006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop se performance for hypersonic air outgrowth of other efforts withi	vehicles in pron		• •		•	0.0	000	0.000	1.313	1.364
	In FY 2006: Not Applicable.										
	In FY 2007: Not Applicable. In FY 2008: Model hypersonic a accurate and robust navigation t engineering model to assess hyper warfighter utility.	techniques for sp	pace-based app	plications. Dev	elop constructi	ve systems					
(U)	In FY 2009: Design RF hardwar characteristics, platform trajector space-based applications. Demo navigation techniques in terms of	ories, and highly onstrate constru	v accurate and a ctive systems of	robust navigati engineering mo	on techniques f odel to assess h	for					
(U)	Total Cost			0			0.0	000	8.848	10.244	8.948
(U)	C. Other Program Funding Su	ımmarv (\$ in N	(fillions)								
		<u>FY 2006</u> <u>Actual</u>	FY 2007 Estimate	FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	FY 2011 Estimate	<u>FY 2012</u> Estimate	<u>FY 2013</u> Estimate	Cost to Complete	Total Cost
(U)	Related Activities:									-	
. ,	PE 0602500F, Multi-Disciplinary Space Tech.										
(U)	PE 0603203F, Advanced Aerospace Sensors.										
. ,	PE 0603500F, Multi-Disciplinary Adv Dev Space Tech.										
(U)	This project has been coordinated through the Reliance 21 process to										
	Remainee 21 process to				R-1 Line Item No	. 9					
	ect 44SP										PE 0602204F)

Exhibit R-2a, RDT&E	Project Justification	DATE February 2007
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 44SP Space Sensors
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
harmonize efforts and eliminate duplication.		
U) <u>D. Acquisition Strategy</u> Not Applicable.		
Project 44SP	R-1 Line Item No. 9 Page-18 of 37	Exhibit R-2a (PE 0602204

E	Exhibit R-	2a, RDT&B	E Project .	Justificatio	on			DATE	February	2007
BUDGET ACTIVITY 02 Applied Research					IBER AND TITL 04F Aerospa	.∈ ace Sensors		OJECT NUMBE		ch
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4916 Electromagnetic Tech	17.746	21.252	12.513	11.808	11.625	12.178	12.449	12.751	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
(U) <u>A. Mission Description and Budget I</u> This project develops technologies for RF antennas and associated electronics air moving target indicators in extreme low-cost active sensors that use reliable develops passive multi-dimensional sentence.	sensor system for airborne a ly cluttered en high-perform	ns that cover the and space-base nvironments. nance solid sta	ed surveillanc The project de ate componen	<ul> <li>e. It also inverse in the second secon</li></ul>	estigates RF sc and passive E etection and id	cattering pheno EO sensors for lentification ar	omenology for use in concer	r applications t with RF sens	in ground and sors. It develo	l ops
<ul> <li>(U) <u>B. Accomplishments/Planned Progra</u></li> <li>(U) MAJOR THRUST: Investigate detect airborne or space-based surveillance p</li> </ul>	on of difficul		l ground-based	d targets in clu	itter from	<u>FY 20</u> 2.9		<u>7 2007</u> 3.563	<u>FY 2008</u> 3.128	<u>FY 2009</u> 3.234
<ul> <li>(U) In FY 2006: Developed integration teasignal processing for improved target of</li> <li>(U) In FY 2007: Develop integration technic physics models with signal processing</li> <li>(U) In FY 2008: Develop techniques for free phenomenology, cognitive algorithms distributed sensing.</li> <li>(U) In FY 2009: Develop analytical and cata dependent EM models of target (U)</li> </ul>	letection. iques for mul for improved ally adaptive and signal pro omputationall tion in a know	tiple platform target detections sensing and processing pertangle y efficient toor wledge-aided	s, combining l on. rocessing com ining to wavel ols for multi-se	EM target and bining EM form diverse s ensor integrati	clutter ensing and on for					
<ul> <li>(U) MAJOR THRUST: Design and developed (U) In FY 2006: Developed and demonstralgorithms that achieve wideband digited developed advanced 3-D micro-electrocircuit design flexibility and reduce the developed novel designs for rugged, we applications.</li> <li>(U) In FY 2007: Develop nonlinear embedding and the second secon</li></ul>	ated novel RF al beamformi -mechanical e size and cos ideband, low-	F and digital hang for multi-f systems (MEM t of microwav -profile confor ns that enhance	ardware archit function phase MS) RF structure integrated ci rmal antennas ce dynamic ran	tectures and en d arrays. Anal ures that impro ircuits. Investi for airborne nge and bandy	lyzed and ove RF gated and vidth of	3.1	11	3.774	3.331	3.444
digital beamforming hardware, enablir Project 4916	g the use of l	ower cost hard	R-1	nstrate the inte Line Item No. 9 Page-19 of 37 221	-				Exhibit R-2a (F	PE 0602204F)

Exhibit R-2a, RDT&E Project Justification		DATE February 2007				
	PE NUMBER AND TITLE 0602204F Aerospace Sensors			ch		
U) B. Accomplishments/Planned Program (\$ in Millions) microwave integrated circuits into low-cost 3-D MEMS RF structures designed for a miniature seeker radar. Analyze and develop digital beamforming architectures for conformal phased array antennas for future air-to-air radar system applications.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
<ul> <li>U) In FY 2008: Integrate optimal algorithms with mixed circuit RF wide-band beamforming hardware to demonstrate lower cost lightweight sensor platforms. Demonstrate low-cost miniature seeker hardware. Transition newly developed digital beamforming architectures to new airborne radar platforms.</li> <li>U) In FY 2009: Develop new low-cost digital beamforming techniques for miniature unmanned aerial</li> </ul>						
vehicle (UAV). Integrate new detection algorithm with low cost seeker hardware. Integrate and test new conformal digital beamforming phased array antennas on airborne radar platforms.	W					
<ul><li>U) MAJOR THRUST: Design and develop new EO techniques and components for detecting and</li></ul>	2.545	3.281	2.724	2.816		
<ul> <li>identifying concealed targets.</li> <li>U) In FY 2006: Tested newly developed avalanche photo diodes (APD) integrated with electronic readout circuits. Integrated subcomponents with flash laser radar (LADAR) system and performed live tests to evaluate guidance and range resolution capability. Tested and evaluated next generation APD designs and incorporated in 3-D LADAR test-bed. Developed quasi-phased matched materials for laser wavelength conversion applications.</li> </ul>						
U) In FY 2007: Develop Zinc Oxide (ZnO), Aluminum Nitride (AlN) and Gallium Nitride (GaN) semiconductors for high power, high temperature EO applications. Develop single crystal GaN substrates for use in detection of biological agents in clouds and in harsh battlefield environments. Use developed LADAR techniques to extend range of agent and target detection. Develop ZnO, GaN, and AlN-based APDs for increased range and detection sensitivity and for non-line-of-sight covert communications.						
U) In FY 2008: Develop new Focal Plane Array (FPA) materials and APD device technologies to enhance autonomous munitions, staring FPAs, target identification and tracking applications. Develop 2-D pixel-based electronic control circuits for enhanced imaging. Integrate these FPAs with the electronic control circuits for a compact 3-D FPA capability.	•					
U) In FY 2009: Develop new quasi-phase matched materials such as Gallium Phosphate (GaP) and techniques for efficient optical sources in the mid- and long- wave IR applications. Develop new material systems to enable conversion from pump wavelengths between one and two microns. Continue testing of integrated FPA.	e					
U)						
R-1 Line Item No. 9				PE 0602204F)		

Exhibit R-2a, RDT&E Proj		DATE February 2007				
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TI 0602204F Aeros			BER AND TITLE		
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) MAJOR THRUST: Develop hardware and software for passive multi-dir thermal infrared spectral wavelength range at high frame rates.</li> </ul>	mensional sensing in the	<u>FY 2006</u> 3.110	<u>FY 2007</u> 3.661	<u>FY 2008</u> 3.330	<u>FY 2009</u> 2.314	
(U) In FY 2006: Designed dual band tomographically based sensor system ut (CDP) to characterize energetic battlefield events in real-time. Created C in-house calibration and performance evaluation. Refined CDP technique declaration and reduce false alarms. Designed and developed micro-lens real-time threat warning and battle damage assessment.	CDP prototype and began es used to validate target multi-spectral sensor for					
(U) In FY 2007: Continue evaluation of CDP-based sensor system performar CDP-based sensor system to field testing of various assets of interest and validation and reduction of false alarms. Continue design and development sensor for real-time threat warning and battle damage assessment. Evaluate sensor performance for real-time threat warning and battle damage assessment.	integration of CDP for target ent of micro-lens multi-spectral ate micro-lens multi-spectral					
(U) In FY 2008: Perform critical technical assessments via field testing on hy developed in prior years. Evaluate the potential of sensing rapidly changi battlefield events (rocket propelled grenades, mortars, man-portable air de Use results of collections to define small portable systems that can be fiel information to commanders about the location and type of weapons being Perform initial testing on a new hyperspectral approach to finding and ide	ing EO spectra from hot efense systems, muzzle flash). ded to provide rapid tactical g fired at friendly forces.					
(U) In FY 2009: Develop new EO sensor hardware for detecting chemical, bi nuclear weapons using spectral/hyperspectral intelligence. Perform initia detection and identification, viability, and initiate plan for transition. Cor hyperspectral and multispectral sensors and create a small, deployable ins into transition with an advanced technology demonstrator. Initiate utility sensors for collecting data at millisecond sample rates for space based app	I testing to assess sensor ntinue development of strument suitable for moving assessment of hyperspectral					
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Optical Maximum Entropy Verification (OM)</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Optical Maximum</li> </ul>		0.976	0.000	0.000	0.000	
<ul> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>						
(U) CONGRESSIONAL ADD: Stable Articulating Backbone for Ultralight I	Radar (SABUR).	0.975	0.000	0.000	0.000	
Project 4916	R-1 Line Item No. 9 Page-21 of 37			Exhibit R-2a (F	PE 0602204F)	

Exhibit R-2a, RDT&E Pro	oject Justification		DATE	DATE February 2007		
BUDGET ACTIVITY 02 Applied Research	_	PE NUMBER AND TITLE 0602204F Aerospace Sensors			ch	
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for SABUR.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Center for Advanced Sensor and Communi</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for the Center for Communication Antennas.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for the Center for Communication Antennas.</li> </ul>	for Advanced Sensor and	1.169	1.594	0.000	0.000	
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Phased Array Antenna Control Computer.</li> </ul>		0.975	0.996	0.000	0.000	
<ul> <li>(U) In FY 2006: Conducted Congressionally-directed effort for the Phased Computer.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for the Phased Ar</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	-					
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Compact Ultra-sensitive Optical Receiver f Weapons.</li> </ul>	for Smart and Loitering Standoff	0.976	1.992	0.000	0.000	
<ul> <li>(U) In FY 2006: Conducted Congressionally-directed effort for a Compact for Smart and Loitering Standoff Weapons.</li> <li>(U) In FY 2007: Conduct Congressionally directed effort for a Compact III</li> </ul>	-					
<ul> <li>(U) In FY 2007: Conduct Congressionally-directed effort for a Compact Ul for Smart and Loitering Standoff Weapons.</li> <li>(U) In FY 2008: Not Applicable.</li> </ul>	itra-sensitive Optical Receiver					
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>						
<ul> <li>(U) CONGRESSIONAL ADD: Hanscom AFB Collaboration on Meta-Mat Technologies.</li> </ul>		0.986	0.996	0.000	0.000	
(U) In FY 2006: Conducted Congressionally-directed effort for Hanscom A	AFB Collaboration on R-1 Line Item No. 9					
Project 4916	Page-22 of 37			Exhibit R-2a (F	PE 0602204F)	

	EXNIDI	R-2a, RDI	&E Projec	t Justificat	tion			DATE	February	2007
BUDGET ACTIVITY D2 Applied Research					UMBER AND TIT 204F Aeros	TLE Dace Sensors	5	PROJECT NUMBI		:h
<ul> <li>U) <u>B. Accomplishments/Planne</u> Meta-Materials and Conforma</li> <li>U) In FY 2007: Conduct Congre Meta-Materials and Conforma</li> <li>U) In FY 2008: Not Applicable.</li> <li>U) In FY 2009: Not Applicable.</li> </ul>	al Antenna Techno ssionally-directed	ologies. effort for Han	scom AFB Co	llaboration on		<u>FY 20</u>	<u>06</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>U)</li> <li>U) CONGRESSIONAL ADD: W</li> <li>U) In FY 2006: Not Applicable.</li> <li>U) In FY 2007: Conduct Congre Array.</li> <li>U) In FY 2008: Not Applicable.</li> <li>U) In FY 2009: Not Applicable.</li> </ul>	_		-	-	ronic Sensing	0.0	00	1.395	0.000	0.000
U) Total Cost						17.7	46	21.252	12.513	11.808
U) <u>C. Other Program Funding S</u>	•									
<ul> <li>U) Related Activities:</li> <li>U) PE 0602500F, Multi-Disciplinary Space Technology.</li> <li>U) PE 0602702F, Command Control and Communications.</li> <li>U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>U) D. Acquisition Strategy Not Applicable.</li> </ul>	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimat		<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Project 4916				R-1 Line Item No Page-23 of 37					Exhibit R-2a (F	E 0602204F

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	T ACTIVITY plied Research					IBER AND TITL 04F Aerospa		oject numbe <b>95 Sensor F</b>		nology	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2006FY 2007ActualEstimate		FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
6095	Sensor Fusion Technology	16.754	18.578	18.335	18.118	18.109	18.295	18.643	19.030	Continuing	TBE
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
T ta tl	A. Mission Description and Budget This project develops the technologies arget recognition (ATR), integrated fin that help to precisely locate, identify, a vill enable new covert tactics for succ	required to pare control, and target airb	erform manag l bomb damag orne and surfa	e assessment. ice targets. Th	This project he project emp	determines the	e feasibility of	technologies	and concepts t	for fire contro	ol
(U) <u>I</u> (U) N r	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop and asse apidly finding, tracking, and targeting n FY 2006: Developed improvement	<b>am (\$ in Mill</b> ess single and g mobile targe	<b>ions)</b> multi-sensor A ts.	ATR and sense	or fusion algor		<u>FY 20</u> 2.7		<u>7 2007</u> 2.214	<u>FY 2008</u> 2.182	<u>FY 2009</u> 2.362
( 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	SAR) data from research and develop malysis and truthing tools. Develope &D and operational data sets. Comp via software, hardware, and network is of real-time ATR algorithms for time- ystems. Conducted laboratory tests a automated exploitation and weapon de esearch for radar, electro-optical (EC irst multi-sensor ATR performance p arget tracking and identification (ID) nethods and measures for assessing a post-conflict force protection, stability	pment (R&D) d synthetic da pleted initial A ntegration enf- critical targets and assessmen elivery system 0), and multipl rediction mod approaches us utomated expl y, and security	data collection ta generation to ATR R&D com- nancements. Co- s on embedded t of multi-sens ts. Conducted e sensor ATR el. Assessed to sing multiple s loitation and ra operations.	ns. Completed ools to augment oons to augment oputer and net completed assort high-perform sor and sensor ATR perform technologies. methods and methods and methods apid response	d automated in ent and enhance working infras- essing the effe- nance computi- fusion algorit nance evaluation Laboratory te neasures for m Developed ana systems propo	nage e collected structure ctiveness ng hms for on theory ested the noving alysis osed for					
H C S A A Z	n FY 2007: Continue to develop imp &D data collections. Continue develop collected R&D and operational data so ensor fusion algorithms for automate ATR performance evaluation theory f ATR technologies. Laboratory test th assessment methods and measures for ypes. Continue development of analy	elopment of sy ets. Continue d exploitation for radar ATR e first multi-se moving targe	nthetic data ge laboratory tes and weapon c technology an ensor ATR per t tracking and	eneration tools ts and assessm lelivery syster d continue for formance pre ID approache for assessing a	s to augment a nent of multi-s ns. Complete r EO and multi diction model. ss using multip	nd enhance ensor and initial iple sensor Continue le sensor loitation					
				11-1							

	Exhibit R-2a, RDT&E Project Jus	tification		DATE February 2007				
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospac	e Sensors	PROJECT NUM 6095 Senso				
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> and rapid response systems proposed for post-conflict force protection, stability, and In FY 2008: Develop improved image formation and processing of SAR data from collections to enhance those features that most impact ATR detection and classifica Continue to develop image and data formation and processing of EO, infrared (IR), imaging (HSI) data from R&D data collections. Continue development of multi-set synthetic data generation tools to augment and enhance collected R&D and operation Continue laboratory tests and assessment of multi-sensor and sensor fusion algorith	R&D data tion performance. and hyperspectral nsor/multi-frequency onal data sets.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	exploitation and weapon delivery systems. Enhance ATR performance evaluation to ATR technology and continue for EO and multiple sensor ATR technologies. Conti- methods and measures for moving target tracking and ID approaches using multiple Continue development of analysis methods and measures for assessing automated er- response systems proposed for post-conflict force protection, stability, and security In FY 2009: Assess the image formation and processing of SAR, EO/IR/HSI data f collections taking advantage of disparate phenomenology to improve ATR detection identification performance. Develop and validate multi-sensor/multi-frequency syn generation tools required to augment and enhance collected R&D and operational d development of tools and technology supporting other phenomenological features the not been exploited. Continue laboratory tests and assessment of multi-sensor and sea algorithms for automated exploitation and weapon delivery systems. Enhance ATR evaluation techniques for radar ATR technology and continue for EO and multiple sensor types. Demonstrate initial analysis methods and measures for exploitation and rapid response systems proposed for post-conflict force protection, security operations.	inue assessment e sensor types. xploitation and rapid operations. rom R&D data n, classification and thetic data ata sets. Initiate nat heretofore have ensor fusion . performance sensor ATR ng and ID approaches assessing automated						
	MAJOR THRUST: Develop, evaluate, and demonstrate target signature models to sensor fusion algorithm development and testing for reconnaissance and strike miss In FY 2006: Matured target signature models for signature exploitation of radio free	ion applications.	5.263	3.116	5.635	5.887		
	EO multi-spectral systems, and signals intelligence (SIGINT) sensors. Developed s algorithms, and modeling support for RF and multiple EO phenomenology ATR of targets. Generated synthetic air and ground target signatures with sufficient fidelity recognition of targets in operationally realistic mission environments. Developed a	ignatures, tactical ground to support automatic						
Proj		-25 of 37			Exhibit R-2a (P	PE 0602204F)		

BUDGET ACTIVITY         PENUMBER AND TITLE         PROLVMBER AND TITLE         PROLVMBER AND TITLE         PROLVMBER AND TITLE         G092204F Aerospace Sensors         BODZECT NUMBER AND TITLE         G092204F           (1)         B. Accomplishments/Thanned Program (\$ in Millions)         EY 2002         EY 2003         EY 2003         EY 2003         EY 2009         EY 2004         EY 2004         EY 2009         EY 2009 <t< th=""><th></th><th>Exhibit R-2a, RDT&amp;E Project Jus</th><th>tification</th><th>DATE</th><th>EFebruary 2007</th></t<>		Exhibit R-2a, RDT&E Project Jus	tification	DATE	EFebruary 2007
generation capability for RF scenes applicable to large area recomaissance coverage. Conducted investigation of model-driven spectral signal processing and exploitation techniques. Developed ATR algorithm-driven RF sensor design, new modes of operation for cxisting sensors, and signal processing/exploitation for high diversity data. (1) In FY 2007: Continue to mattere target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algorithms, and modeling support for multiple RF and EO phenomenology ATR of tactical ground targets. Continue to generate synthetic air and ground larget signatures with sufficient fidelity to support ATR of targets in operationally realistic mission environments. Demonstrate a synthetic scene data generation capability for RF scenes and begin development of an EO scene capability applicabile to large care recomainsance coverage. Continue investigation of model-driven spectral signal processing and exploitation techniques. Continue development of ATR algorithm-driven RF sensor design, new modes of operation for existing sensors, and SIGINT sensors. Develop signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Develop signatures, algorithms, and modeling technologies and their supporting tools for analysis and evaluation for multiple RF and EO phenomenology ATR of tactical ground targets introduce civilian vehicles. Continue to generate synthetic air and ground larget signatures and continue development of an Synthetic scene data generation capability for FF scenes and continue development of an Synthetic scene data generation capability for FF scenes and continue development of an synthetic scene data generation capability for FF scenes and continue development of an synthetic scene data generation exploiting to signature widels for signature exploitation for high diversity data. (1) In FY 2009: Continue to mature target signature models for signature exploitation for high					
(1)       In FY 2007: Continue to mature target signature models for signature exploitation of RF sensors. EO         multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algorithms, and modeling         support for multiple RF and EO phenomenology ATR of tactical ground targets. Continue to generate         synthetic air and ground target signatures with sufficient fidelity to support ATR of targets in         operationally realistic mission environments. Demonstrate a synthetic scene data generation capability         for RF scenes and begin development of an EO scene capability applicable to large area reconnaissance         coverage. Continue investigation of model-driven spectral signature works of operation         for existing sensors, and signal processing/exploitation for high diversity data.         (1)       In FY 2008: Develop and validate target signature models for signature exploitation of RF sensors, EO         multi-spectral systems, and SIGINT sensors. Develop signatures. algorithms, and modeling         technologies and their supporting tools for analysis and evaluation for multiple RF and EO         phenomenology ATR of tackcal ground targets introduce civilian vehicles. Continue to generate         synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of         targets in operationally realistic mission environments. Compatible demonstration of a synthetic scene         data generation capability of RF sensors, and signal processing/exploitation         for target sin operationally realisti	(U)	generation capability for RF scenes applicable to large area reconnaissance coverage investigation of model-driven spectral signal processing and exploitation techniques algorithm-driven RF sensor design, new modes of operation for existing sensors, and	e. Conducted . Developed ATR	<u>FY 2007</u>	<u>FY 2008 FY 2009</u>
synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Complete demonstration of a synthetic scene data generation capability for RF scenes and continue development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal processing and exploitation techniques. Measure performance of initial ATR algorithm-driven RF sensor design, including new modes of operation for existing sensors, and signal processing/exploitation for high diversity data. (U) In FY 2009: Continue to mature target signature models for signature exploitation of RF sensors, EO multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algorithms, and modeling support for multiple RF and EO phenomenology ATR of tactical ground targets and civilian vehicles. Initiate the development of signatures, algorithms, target modeling and phenomenological modeling of other phenomenological features that heretofore have not been exploited. Continue to generate synthetic air and ground target signatures with sufficient fidelity to support automatic recognition of targets in operationally realistic mission environments. Continue development of an EO scene capability applicable to large area reconnaissance coverage. Continue investigation of model-driven spectral signal Project 6095 Project 6		In FY 2007: Continue to mature target signature models for signature exploitation of multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algori support for multiple RF and EO phenomenology ATR of tactical ground targets. Construct air and ground target signatures with sufficient fidelity to support ATR of operationally realistic mission environments. Demonstrate a synthetic scene data get for RF scenes and begin development of an EO scene capability applicable to large a coverage. Continue development of ATR algorithm-driven RF sensor design, new for existing sensors, and signal processing/exploitation for high diversity data. In FY 2008: Develop and validate target signature models for signature exploitation multi-spectral systems, and SIGINT sensors. Develop signatures, algorithms, and m technologies and their supporting tools for analysis and evaluation for multiple RF and SIGINT sensors.	thms, and modeling ontinue to generate targets in eneration capability area reconnaissance ploitation v modes of operation of RF sensors, EO nodeling and EO		
Project 6095 Page-26 of 37 Exhibit R-2a (PE 0602204F)	(U)	synthetic air and ground target signatures with sufficient fidelity to support automatic targets in operationally realistic mission environments. Complete demonstration of data generation capability for RF scenes and continue development of an EO scene of to large area reconnaissance coverage. Continue investigation of model-driven spec processing and exploitation techniques. Measure performance of initial ATR algorit sensor design, including new modes of operation for existing sensors, and signal pro- for high diversity data. In FY 2009: Continue to mature target signature models for signature exploitation of multi-spectral systems, and SIGINT sensors. Continue to develop signatures, algori support for multiple RF and EO phenomenology ATR of tactical ground targets and Initiate the development of signatures, algorithms, target modeling and phenomenol- other phenomenological features that heretofore have not been exploited. Continue air and ground target signatures with sufficient fidelity to support automatic recogni- operationally realistic mission environments. Continue development of an EO scene	ic recognition of a synthetic scene capability applicable tral signal thm-driven RF ocessing/exploitation of RF sensors, EO thms, and modeling civilian vehicles. ogical modeling of to generate synthetic tion of targets in e capability		
	Pro	ect 6095 Page	26 of 37		Exhibit R-2a (PE 0602204F)

Exhibit R-2a, RDT&E Project Justification		DATE February 2007				
	PE NUMBER AND TITLE 0602204F Aerospace Sensors			nology		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> processing and exploitation techniques. Continue development of ATR algorithm-driven RF sensor design, new modes of operation for existing sensors, and signal processing/exploitation for high diversity data.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop and demonstrate enabling ATR, sensor management, and sensor fusion technologies for target detection, tracking, and identification in intelligence, surveillance, reconnaissance (ISR) and combat identification (CID) applications.</li> </ul>	7.796	12.152	9.021	8.367		
<ul> <li>(U) In FY 2006: Conducted fusion of exploitable radar, EO/infrared (IR), laser radar (LADAR), and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluated physics-based techniques for target detection and identification for ISR and CID applications. Transitioned to advanced development programs laboratory demonstrated advanced algorithms for detection and identification of targets under trees and/or in the presence of heavy camouflage, concealment, and deception. Developed technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Developed capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Conducted research of bio-inspired ATR for robustness. Researched ATR, sensor management, and sensor fusion for urban ISR from small unmanned aerial vehicles (UAVs).</li> </ul>						
(U) In FY 2007: Continue fusion of exploitable radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Continue evaluation of physics-based techniques for target detection and ID for ISR and CID applications. Continue development of technology that will capitalize on precision time, position, attitude, and velocity sensor data to enable improved geo-location capabilities for future distributed time and distributed platform sensing. Begin investigation of pixel level registration techniques. Continue development of capabilities to represent and utilize sensor parameters and errors, along with other uncertainty reference information, for improved fused geo-location accuracy. Continue research of bio-inspired ATR for robustness. Continue ATR, sensor management, and sensor fusion research for urban ISR from small UAVs						
(U) In FY 2008: Develop and validate a fusion capability that exploits radar, EO/IR, LADAR, and hyperspectral features for target detection, tracking, and ID with sensor management techniques. Evaluate physics-based techniques for target detection and identification for ISR and CID applications to determine technology shortfalls. Initiate development of automated battle space behavior analysis. Continue development and initiate assessment of technology that will capitalize on precision time,						

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospace			IBER AND TITLE r Fusion Tech	nology
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> position, attitude, and velocity sensor data to enable improved geo-location capabilit distributed time and distributed platform sensing. Continue development of multi-se registration techniques. Continue development of capabilities to represent and utiliz and errors, along with other uncertainty reference information, for improved fused g accuracy. Continue research of bio-inspired ATR for robustness. Extend ATR, sense and sensor fusion research for urban ISR from small UAVs to include civilian objec	ensor pixel level e sensor parameters eo-location sor management,	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Complete initial fusion capability for radar, EO/IR, LADAR, and hype target detection, tracking, and ID with sensor management techniques. Evaluate and physics-based techniques for target detection and identification for ISR and CID app development and initiate evaluation of automated battle space behavior analysis. Co of technology that will capitalize on precision time, position, attitude, and velocity s improved geo-location capabilities for future distributed time and distributed platfor its incorporation into fusion functions. Complete and evaluate initial multi-sensor, pregistration techniques. Continue development of capabilities to represent and utiliz and errors, along with other uncertainty reference information, for improved fused g accuracy. Continue research of bio-inspired ATR for robustness and initiate evaluate techniques for urban applications. Evaluate ATR, sensor management, and sensor for difficult urban ISR from small UAVs for civilian objects of interest.	rspectral features for l improve olications. Continue ontinue development ensor data to enable m sensing; initiate oixel level e sensor parameters eo-location ion of these				
(U)						
(U) (U) (U)		nnologies impacted	0.000	0.000	1.497	1.502
(U)	In FY 2008: Assess the state of the art in ATR predictive methods. Determine expl technologies that require the integration of ATR techniques. Develop fundamental a various subcomponents.	-				
(U)	In FY 2009: Evaluate new innovations in ATR related technologies. Continue deve fundamental ATR approaches for subcomponents. Begin development of integrated methodology building upon the various ATR subcomponent efforts.	•				
(U)						
(U)	CONGRESSIONAL ADD: Advanced Sensor Aided Vigilance Technologies.		0.975	1.096	0.000	0.000
Pro	ject 6095 Page-	Item No. 9 28 of 37			Exhibit R-2a (F	PE 0602204F)
	2	230				

	Exhibit	R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007	
BUDGET ACTIVITY 02 Applied Research					UMBER AND TI 2204F Aeros		S		T NUMBER AND TITLE ensor Fusion Technology		
<ul> <li>(U) B. Accomplishments/Planned I</li> <li>(U) In FY 2006: Conducted Congre Technologies.</li> <li>(U) In FY 2007: Conduct Congressi Technologies.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> </ul>	ssionally-direc	ted effort for A				<u>FY 2</u> 16.		<u>FY 2007</u> 18.578	<u>FY 2008</u> 18.335	<u>FY 2009</u> 18.118	
(U) <u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u> <u>FY 2006</u>	<u>1illions</u> ) <u>FY 2007</u>	<u>FY 2008</u>	FY 2009	<u>FY 2010</u>	<u>FY 2011</u>	FY 2012	<u>2 FY 2013</u>	<u>Cost to</u>		
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602500F, Multi-Disciplinary Space Technology.</li> <li>(U) PE 0603203F, Advanced Aerospace Sensors.</li> <li>(U) PE 0602602F, Conventional Munitions.</li> <li>(U) PE 0603270F, Electronic Combat Technology.</li> <li>(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.</li> <li>(U) PE 0603762E, Sensor and Guidance Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimat	<u>te Estimate</u>	Complete	Total Cost	
Project 6095				R-1 Line Item No Page-29 of 37					Exhibit R-2a (I		

Exhibit R-2a, RDT&E	DATE February 2007			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology		
(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.				
Not Applicable.				
Project 6095	R-1 Line Item No. 9 Page-30 of 37	Exhibit R-2a (PE 0602204F)		

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007	
	ET ACTIVITY oplied Research	0602204F Aerospace Sensors 7622 RF S								NUMBER AND TITLE Sensors & neasures Tech		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
7622	RF Sensors & Countermeasures Tech	35.851	34.248	25.796	26.061	34.244	35.088	31.301	32.016	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0			
Note:	In FY 2006 efforts in Project 5017 tr	ansferred to th	nis project in o	order to more e	effectively man	nage and prov	ide oversight o	of the efforts.				
s I I t t t	This project develops and assesses aff ensors including intelligence, surveil SR, fire control radar, electronic com RF signatures that are difficult to dete exploited include the use of multiple I echniques. This project also develop echnologies to detect and counter the echnologies and components to provi applications.	lance, reconna bat (EC), and ct due to reduc RF phenomeno s the RF warni links and sens	issance (ISR) integrated rad ced radar cross ologies, multi- ing and counte sors of threat a	and fire contr ar and EC sys s sections, cor dimensional a ermeasure tech ir defense sys	ol, both active stems. It emph acealment and adaptive process anology for ad stems and host	and passive. hasizes the detection camouflage m ssing, advance vanced EC ap ile command a	This project a ecting and trac leasures, seven d waveforms, plications. Sp and control ne	lso develops a eking of surface e clutter, or h and knowled becifically, it d tworks. The p	and evaluates ce and airborn eavy jamming ge-aided proce levelops techn project also ex	technology for e targets with g. Techniques essing iques and ploits emergin		
(U) 1 (U) 1	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop affordal vehicle survivability by degrading en Effort completes in FY 2006. In FY 2006: Completed developmen simulator that contains both adversar	ble RF jammir emy radar, mis t and test of a o	ng technology ssile, and com complex signa	mand and con	trol systems.	Note: ent	<u>FY 20</u> 1.6		<u>¥ 2007</u> 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000	
(U) 1 (U) 1 (U) 1 (U) 1	development and test of technology for exploitation evaluations against new, development of networked electronic (In FY 2007: Not Applicable. (In FY 2008: Not Applicable. (In FY 2009: Not Applicable. (In FY 2009: Not Applicable. (In FY 2009: Not Applicable.)	advanced RF attack techniq ed waveforms	threats. Perforues.	rmed explorat transmit adap	ory research in	nto ultaneous	5.0	99	18.196	12.759	15.887	
	exploiting diversity in frequency, dela	•	-	tion and codir	ng. Develop te	echnologies						
Proje	ct 7622				1 Line Item No. 9 Page-31 of 37 233	)				Exhibit R-2a (P	E 0602204F)	

DUDGET ACTIVITY         PE NUMBER AND TITLE         PROJECT NUMBER AND TITLE           02 Applied Research         0602204F Aerospace Sensors         7622 RF Sensors & Countermeasures Tech           (U)         B. Accomplishments/Planned Program (\$ in Millions) and techniques to provide significant size, weight, and power (SWaP) reductions in RF sensors compatible with severely constrained unmanned air platforms. Develop technology to enable affordable upgrades to RF signal receivers. Note: There is increased emphasis on this effort beginning in FY 2007.         EY 2006         EY 2007         EY 2008         EY 20           U) In FY 2006: Identified and analyzed advanced receiver/exciter techniques for operation with temporally and spatially adaptive electronic support (ES) and radar antenna systems. Identified and analyzed advanced digital signal processing techniques that support distributed and adaptive ES and radar receiver/sciter sensor systems. Minimized SWaP for advanced agentures and receivers, waveform diversity, assured reference, and machine-to-machine sensor cross cueing. Investigated innovative techniques to provide concurrent RF radar and electronic warfare (EW) with electro-optical (EO) compatibility on a single platform. Developed integrate dradar and EW modeling, simulation, and analysis capabilities to address system-level multi-intelligence trades.         EV and advanced signal processing concepts that seamlessly integrate with receiver technologies to support increased levels of adaptivity for operation in complex signal environments. Continue development to reduce size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms. Refine innovative techniques to provide concurrent RF radar and EW with EO compatibility on a single platform. Determine system-level multi-in		Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
<ul> <li>and techniques to provide significant size, weight, and power (SWaP) reductions in RF sensors</li> <li>compatible with severely constrained unmanned air platforms. Develop technology to enable alfordable</li> <li>upgrades to RF signal receivers. Note: There is increased emphasis on this effort beginning in FY</li> <li>2007.</li> <li>(U) In FY 2006: Identified and analyzed advanced receiver/exciter techniques for operation with temporally</li> <li>and spatially adaptive electronic support (ES) and radar antenna systems. Identified and analyzed</li> <li>advanced digital signal processing techniques that support distributed and adaptive ES and radar</li> <li>receiver/exciter sensor systems. Minimized SWaP for advanced apertures and receivers, waveform</li> <li>diversity, assured reference, and machine-to-machine sensor cross cueing. Investigated innovative</li> <li>techniques to provide concurrent RF radar and electronic warfare (EW) with electro-optical (EO)</li> <li>compatibility on a single platform. Developed integrated radar and EW modeling, simulation, and</li> <li>analysis capabilities to address system-level multi-intelligence trades.</li> <li>(U) In FY 2007: Develop and evaluate advanced digital receiver/exciter technologies for ES and radar</li> <li>applications that support multiple degree-of-freedom adaptivity. Develop and evaluate advanced signal</li> <li>processing concepts that seamlessly integrate with receiver technologies to support increased levels of</li> <li>adaptivity for operation in complex signal environments. Continue development to reduce size, weight,</li> <li>and power in RF sensors compatible with severely constrained unmanned air platforms. Refine</li> <li>innovative techniques to provide concurrent RF radar and EW with EO compatibility on a single</li> <li>platform. Determine system-level multi-intelligence trades through integrated radar and EW modeling,</li> <li>simulation, and analysis.</li> <li>(U) In FY 2008: Develop on ad evaluate advanced mode control concepts to pro</li></ul>				e Sensors	7622 RF Se	nsors &	
<ul> <li>and spatially adaptive electronic support (ES) and radar antenna systems. Identified and analyzed advanced digital signal processing techniques that support distributed and adaptive ES and radar receiver/exciter sensor systems. Minimized SWaP for advanced apertures and receivers, waveform diversity, assured reference, and machine-to-machine sensor cross cueing. Investigated innovative techniques to provide concurrent RF radar and electronic warfare (EW) with electro-optical (EO) compatibility on a single platform. Developed integrated radar and EW modeling, simulation, and analysis capabilities to address system-level multi-intelligence trades.</li> <li>(U) In FY 2007: Develop and evaluate advanced digital receiver/exciter technologies for ES and radar applications that support multiple degree-of-freedom adaptivity. Develop and evaluate advanced signal processing concepts that seamlessly integrate with receiver technologies to support increased levels of adaptivity for operation in complex signal environments. Continue development to reduce size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms. Refine innovative techniques to provide concurrent RF radar and EW with EO compatibility on a single platform. Determine system-level multi-intelligence trades through integrated radar and EW modeling, simulation, and analysis.</li> <li>(U) In FY 2008: Develop and evaluate advanced mode control concepts to provide concurrent multi-function RF radar and electronic warfare (EW) compatibility on a single platform. Deterlop integrated RF (radar and electronic warfare (EW) compatibility on a single platform. Develop integrated RF (radar and EW and EO modeling, simulation, and analysis capabilities to address broader system-level multi-intelligence trades. Develop advanced digital receiver techniques for adaptive ES for passive multi-indel platform operations. Continue development and evaluate of adaptive ES for passive multi-mode platform operations. Continue development an</li></ul>	(U)	and techniques to provide significant size, weight, and power (SWaP) reductions in F compatible with severely constrained unmanned air platforms. Develop technology upgrades to RF signal receivers. Note: There is increased emphasis on this effort be	to enable affordable	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>applications that support multiple degree-of-freedom adaptivity. Develop and evaluate advanced signal processing concepts that seamlessly integrate with receiver technologies to support increased levels of adaptivity for operation in complex signal environments. Continue development to reduce size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms. Refine innovative techniques to provide concurrent RF radar and EW with EO compatibility on a single platform. Determine system-level multi-intelligence trades through integrated radar and EW modeling, simulation, and analysis.</li> <li>(U) In FY 2008: Develop and evaluate advanced mode control concepts to provide concurrent multi-function RF radar and electronic warfare (EW) compatibility on a single platform. Develop integrated RF (radar and EW) and EO modeling, simulation, and analysis capabilities to address broader system-level multi-intelligence trades. Develop advanced digital receiver techniques for adaptive ES for passive multi-mode platform operations. Continue development and evaluation of advanced digital</li> </ul>	(U)	and spatially adaptive electronic support (ES) and radar antenna systems. Identified advanced digital signal processing techniques that support distributed and adaptive E receiver/exciter sensor systems. Minimized SWaP for advanced apertures and receiv diversity, assured reference, and machine-to-machine sensor cross cueing. Investigat techniques to provide concurrent RF radar and electronic warfare (EW) with electro- compatibility on a single platform. Developed integrated radar and EW modeling, si analysis capabilities to address system-level multi-intelligence trades.	and analyzed S and radar vers, waveform ted innovative optical (EO) mulation, and				
(U) In FY 2008: Develop and evaluate advanced mode control concepts to provide concurrent multi-function RF radar and electronic warfare (EW) compatibility on a single platform. Develop integrated RF (radar and EW) and EO modeling, simulation, and analysis capabilities to address broader system-level multi-intelligence trades. Develop advanced digital receiver techniques for adaptive ES for passive multi-mode platform operations. Continue development and evaluation of advanced digital	(U)	applications that support multiple degree-of-freedom adaptivity. Develop and evalual processing concepts that seamlessly integrate with receiver technologies to support in adaptivity for operation in complex signal environments. Continue development to r and power in RF sensors compatible with severely constrained unmanned air platform innovative techniques to provide concurrent RF radar and EW with EO compatibility platform. Determine system-level multi-intelligence trades through integrated radar	tte advanced signal ncreased levels of educe size, weight, ns. Refine y on a single				
<ul> <li>adaptivity. Continue development and evaluation of advanced digital receiver signal processing concepts/techniques for adaptive operation in complex signal environments. Perform digital receiver simulation, modeling and analysis for ES scenarios in modern signal environments. Refine reductions in size, weight, and power in RF sensors compatible with severely constrained unmanned air platforms.</li> <li>(U) In FY 2009: Continue system-level multi-intelligence trades through integrated RF (radar and EW) and</li> </ul>		In FY 2008: Develop and evaluate advanced mode control concepts to provide conce multi-function RF radar and electronic warfare (EW) compatibility on a single platfor integrated RF (radar and EW) and EO modeling, simulation, and analysis capabilities system-level multi-intelligence trades. Develop advanced digital receiver techniques passive multi-mode platform operations. Continue development and evaluation of ad receiver/exciter technologies for ES and radar applications that support multiple degr adaptivity. Continue development and evaluation of advanced digital receiver signal concepts/techniques for adaptive operation in complex signal environments. Perform simulation, modeling and analysis for ES scenarios in modern signal environments. size, weight, and power in RF sensors compatible with severely constrained unmanner	rm. Develop s to address broader a for adaptive ES for dvanced digital rees-of-freedom processing n digital receiver Refine reductions in ed air platforms.				
R-1 Line Item No. 9 Project 7622 Page-32 of 37 Exhibit R-2a (PE 06022)		R-1 Line	Item No. 9			Exhibit R-2a (I	PE 0602204F)

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospace	e Sensors	7622 RF Sei	IBER AND TITLE Isors & Isures Tech	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> EO modeling, simulation, and analysis. Continue to develop and evaluate advanced a concepts to provide concurrent RF radar and EW with EO compatibility on a single p approaches allowing the simultaneous design and development of sensors and their b exploitation functions. Develop advanced ES digital receiver concepts/techniques for temporal adaptivity to overcome limitations to precision emitter parameterization in a environments. Continue development and evaluation of advanced adaptive digital receiver technologies for ES, radar and passive multi-mode applications. Continue digital received modeling and analysis for ES scenarios in modern signal environments. Continue to size, weight, and power in RF sensors compatible with severely constrained unmanned.	latform. Define ack-end r spatial and complex ceiver/exciter eiver simulation, refine reductions in	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop robust, ultra-widebandwidth antenna technology for use future aerospace platform electronic apertures. Develop innovative technologies and extremely wideband apertures to provide for more functionality on a set of platforms generation applied RF aperture technology. In FY 2006: Designed and modeled thin profile, wideband arrays for ES receive app and fabricated array beam steering capability for wideband array jammer transmitter. modeled compact, wideband direction finding antenna. Extended bandwidth perform low profile, low-cost antenna element. In FY 2007: Fabricate and test thin profile, wideband receive array. Extend array to transmit function. Evaluate performance of directional wideband array transmitter. Of fabrication and test of compact, wideband direction finding antenna for close in sensi In FY 2008: Integrate compact digital receiver/exciter to thin-profile array.	e in operational and architectures for . Assess next lications. Designed Designed and nance of unique, accommodate Complete ng.	6.077	4.362	1.004	0.883
(U) (U) (U) (U)	In FY 2009: Lab demonstrate and test thin profile array with integrated receiver/excit MAJOR THRUST: Develop multi-function RF sensing concepts and RF transformat arrays for concurrent multi-mode operation. In FY 2006: Fabricated and laboratory tested low-cost millimeter wave sensor that p indication in addition to azimuth and range for landing in obscured environments. Do position, navigation, and time (PNT) virtual testbed to assess assured reference techn optimal multi-function RF sensor fusion for a Common Operation Picture (COP). Ex- simulations to determine technology shortfalls for full element level digital beam for R-1 Line	tional element level rovides height esigned distributed iques that achieve stended array	2.103	2.822	3.109	1.807
Pro		33 of 37 35			Exhibit R-2a (I	PE 0602204F)

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospac	e Sensors	PROJECT NUM 7622 RF Ser Countermea	IBER AND TITLE	2001
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2007: Design autonomous constellation of active and passive air, space, techniques for close-in sensing applications using distant sources of opportunit engineering analysis of concurrent operation to determine multi-mode array petechnology development of critical subsystems for element level multi-mode I In FY 2008: Develop autonomous constellation of active and passive air, space	y. Perform systems prformance. Initiate DBF.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	techniques for close-in sensing applications using distant sources of opportunity panel technology for multi-mode array to demonstrate concurrent operation. In FY 2009: Lab demonstrate autonomous constellation of active and passive sensor techniques for close-in sensing applications using distant sources of opp and test multi-mode array with element level DBF.	y. Design and develop air, space, and ground				
(U) (U) (U)	MAJOR THRUST: Develop digital RF receiver/exciter technology to support In FY 2006: Developed and modeled DBF-specific receiver/exciter technolog size, weight, and power consumption, as well as increased affordability for ES Demonstrated through simulation and laboratory integration the benefits for D technologies for multi-intelligence RF sensor systems.	ies that stress reduced and radar sensor systems.	6.027	3.669	3.739	1.522
	In FY 2007: Demonstrate receiver/exciter technologies that support DBF function electronic support and radar sensor systems. Perform laboratory integration are reduced size, weight and power consumption receiver/exciter technologies that RF sensor concepts.	nd demonstration of t support multi-function				
	In FY 2008: Develop subsystem engineering, simulation, and characterization integrated wideband RF aperture, wideband receiver/exciter, and DBF signal p In FY 2009: Lab demonstrate advanced wideband RF aperture and wideband signal processing subsystem to validate subsystem engineering, simulation, an technologies.	rocessing. receiver/exciter with DBF				
(U) (U)	MAJOR THRUST: Design exploratory outdoor time transfer experiments bet platforms for enhanced situational awareness. Investigate techniques for multi acquisition from a single platform. Note: Effort completes in FY 2006.	-intelligence data	0.911	0.000	0.000	0.000
		aced electronic 1 Line Item No. 9				
Pro	ject 7622	Page-34 of 37			Exhibit R-2a (F	PE 0602204F)

	Exhibit R-2a, RDT&E Project Just	fication		DATE	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospac		7622 RF Se	CT NUMBER AND TITLE RF Sensors & ermeasures Tech		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> counter-countermeasure (ECCM) techniques. Validated the engineering tools using b field collected data.	both synthetic and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U) (U)	MAJOR THRUST: Develop advanced waveforms for achieving transmit adaptivity a multi-mode operation to improve interference rejection, self-protection, and target ide exploiting diversity in frequency, delay, polarization, and modulation and coding. De multi-platform, multi-mission radar adaptive processing algorithms that improve dete performance for advanced cruise missiles, air- and ground-based targets in severe clu environments.	entification by evelop ction and location	6.733	4.203	5.185	5.962	
(U)	In FY 2006: Evaluated advanced adaptive transmit waveforms for single- and multi- improve interference rejection, self-protection, target identification, and ambiguity re- temporal, spatial, frequency, and polarization diversity. Optimized waveforms for mu- multi-mode operations for moving target indicator (MTI) surveillance platforms. Dev radar signal processing algorithms for multi-sensor, multi-mode operation. Complete development of wideband and polarization adaptive processing techniques for multi-f Evaluated adaptive processing techniques for multi-mission conformal arrays. Comp development of distributed processing technology for next generation deep-reach targe tracking.	solution using ulti-sensor, veloped advanced d initial function radar. leted initial					
(U)	In FY 2007: Develop optimal waveforms for multi-sensor/multi-mode radar. Develor signal processing algorithms that are suitable for multi-sensor, multi-mode operation. wideband radar signal processing techniques for MTI surveillance platforms. Evalua processing technology for next generation deep-reach target detection and tracking.	Evaluate					
(U)	In FY 2008: Evaluate distributed processing technology for next generation deep-rea and tracking. Utilize high fidelity simulation tools. Plan for future experiments.	ch target detection					
(U)	In FY 2009: Initiate and conduct experiments to demonstrate the advantages and per- improvements of adaptive transmit waveforms, new distributed sensor receive proces and distributed sensing.						
(U)							
	ject 7622 R-1 Line I Page-3				Exhibit R-2a (		

Exhibit R-2a, RDT&E Project Ju	stification		DATE	February	2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TIT 0602204F Aerosp		PROJECT NUMB 7622 RF Sens Countermeas	ors &	
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) CONGRESSIONAL ADD: Minority LEADERS Research Program.</li> <li>(U) LEV 2006 Conduct ADD in the New York of the Minority LEADERS</li> </ul>		<u>FY 2006</u> 1.756	<u>FY 2007</u> 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
<ul><li>(U) In FY 2006: Conducted Congressionally-directed effort for the Minority LEADEF</li><li>(U) In FY 2007: Not Applicable.</li></ul>	S Research Program.				
<ul><li>(U) In FY 2008: Not Applicable.</li><li>(U) In FY 2009: Not Applicable.</li></ul>					
(U)					
<ul> <li>(U) CONGRESSIONAL ADD: Small Disadvantaged Business, Historically Black Co Universities.</li> </ul>	leges and	5.461	0.000	0.000	0.000
(U) In FY 2006: Conducted Congressionally-directed effort for Small Disadvantaged	Business, Historically				
Black Colleges and Universities. U) In FY 2007: Not Applicable.					
U) In FY 2008: Not Applicable.					
U) In FY 2009: Not Applicable.					
U) U) CONGRESSIONAL ADD: Sensor Network Technology.		0.000	0.996	0.000	0.000
<ul><li>U) In FY 2006: Not Applicable.</li><li>U) In FY 2007: Conduct Congressionally-directed effort for Sensor Network Technol</li></ul>					
<ul><li>U) In FY 2007: Conduct Congressionally-directed effort for Sensor Network Technol</li><li>U) In FY 2008: Not Applicable.</li></ul>	ogy.				
U) In FY 2009: Not Applicable.		25.951	24 249	25 706	26.061
U) Total Cost		35.851	34.248	25.796	26.061
U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY</u>	2009 FY 2010	<u>FY 2011</u> <u>FY 2</u>	012 <u>FY 2013</u>	Cost to	
	timate Estimate	Estimate Estim		Complete	I OTAL COST
<ul><li>U) Related Activities:</li><li>U) PE 0602500F,</li></ul>					
Multi-Disciplinary Space					
Technology.					
U) PE 0603203F, Advanced Aerospace Sensors.					
U) PE 0603253F, Advanced					
Avionics Integration. R-1 Lir	e Item No. 9				
	238			Exhibit R-2a (I	PE 0602204F

Exhibit R-2a, RDT&E P	Project Justification	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 7622 RF Sensors & Countermeasures Tech
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
<ul> <li>(U) PE 0602782A, Command, Control, Communications Technology.</li> <li>(U) PE 0602232N, Navy C3 Technology.</li> <li>(U) PE 0603792N, Advanced Technology Transition.</li> <li>(U) This project has been coordinated through the Reliance 21 process to</li> </ul>		
harmonize efforts and eliminate duplication.		
(U) <b>D. Acquisition Strategy</b> Not Applicable.		
Project 7622	R-1 Line Item No. 9 Page-37 of 37 239	Exhibit R-2a (PE 0602204F)

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#### PE NUMBER: 0602500F PE TITLE: MULTI-DISCIPLINARY SPACE TECH

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
	T ACTIVITY blied Research					IBER AND TITL D <b>OF MULTI-E</b>	E D <b>isciplina</b> f	RY SPACE T	ECH		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	89.761	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5023	Laser & Imaging Space Tech	7.701	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5025	Space Materials Development	19.197	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5026	Rocket Propulsion Component Tech	48.113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5027	High Speed Airbreathing Prop Tech	0.239	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5028	Space Sensors, Photonics & RF Proc	1.848	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5029	Space Sensor & CM Tech	1.074	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5082	Optical Networking Tech	11.589	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2007, Project 625023, Laser and Imaging Space Technology, efforts transfer to PE 0602605F, Directed Energy Technology, Project 6255SP, Laser and Imaging Space Technology; Project 625025, Space Materials Development, efforts transfer to PE 0602102F, Materials, Project 6210SP, Space Materials Development; Project 625026, Rocket Propulsion Component Technology, and Project 625027, High Speed Airbreathing Propulsion Technology, efforts transfer to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology; Project 625028, Space Sensors, Photonics and Radio Frequency (RF) Processes, and Project 625029, Space Sensor and Countermeasure (CM) Technology, efforts transfer to PE 0602204F, Aerospace Sensors, Project 626244 SP, Space Sensors; Project 625030, Applied Space Access Vehicle Technology, efforts transfer to PE 0602201F, Aerospace Vehicle Technologies, Project 6222SP, Applied Space Access Vehicle Technology; and Project 625027, Command Control and Communication, Project 6266SP, Space Optical Network Technology, in order to more effectively manage and provide oversight of the efforts. Funds for the FY 2007 Congressionally-directed Engineering Tool Improvement Program (ETIP) in the amount of \$2.8 million were moved to PE 0602203F, Aerospace Propulsion, Project 6233SP, Space Rocket Component Technology, and the funds for the Congressional-directed Integrated Control for Autonomous Space Systems were moved to PE 0602601F, Space Technology, Project 628809, Spacecraft Vehicle Technologies, from this PE for execution.

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

This program advances the technology base in multiple disciplines for future space applications with projects focusing on separate technology areas including: 1) laser and imaging space technologies, which develop concepts for advanced, very long-range optical systems and assess the vulnerability of satellites to the effects of high energy laser weapon systems; 2) space materials, which concentrate on the materials technology base for spacecraft and launch systems to improve affordability, maintainability, and performance; 3) rocket propulsion component technologies, which advance technology in liquid propulsion rocket engines, solid rocket motors, spacecraft and upper stage propulsion, ballistic missiles, and application of advanced materials for rockets to achieve revolutionary launch capabilities; 4) high-speed airbreathing propulsion technologies, which develop advanced and combined cycle engine technologies for revolutionary low-cost access to space; 5) space sensors, photonics, and radio frequency processes, which develop technologies to generate, control, process, receive, and transmit opto-electronic signals for space sensor applications; 6) space sensors and countermeasures technologies, which focus on generation, control, reception, and processing of electronic and electromagnetic

Exhibit R-2 (PE 0602500F)

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	Exhibit R-2, RDT&	E Budget Item Justification		DATE Februa	ry 2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLI	NARY SPACE TEC	Э	-
	signals for space sensor applications in intelligence, surveillar technologies, which develop advanced concepts for affordable terminal technology for communications and surveillance; and the warfighter with unlimited communications to any place at (ETIP) and \$1.6 million for Integrated Control For Autonomo determines the technical feasibility and military utility of evol	e on-demand access to space; 8) lightweight satellite ant d 9) optical networking technology, which focuses on the any time. Note: In FY 2007, Congress added \$2.8 mil ous Space Systems. This program is in Budget Activity	enna technology and the space-based laser of lion for Engineering	affordable antenna ommunications to pro Fool Improvement Pr	ovide ogram
(U)	<b>B. Program Change Summary (\$ in Millions)</b>				
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget	91.694	0.000	0.000	0.000
(U)	Current PBR/President's Budget	89.761	0.000	0.000	0.000
(U)	Total Adjustments	-1.933			
(U)	Congressional Program Reductions				
	Congressional Rescissions	-0.005			
	Congressional Increases		4.400		
	Reprogrammings	-0.383	-4.400		
	SBIR/STTR Transfer	-1.545			
(U)	Significant Program Changes:				
	Efforts transfer to other programs in FY07 and out to more eff	fectively manage and provide oversight of the efforts.			
	C. Performance Metrics				
	(U) Under Development.				
		D 4 Line How No. 40			
		R-1 Line Item No. 10 Page-2 of 21		Exhibit R-	2 (PE 0602500F)
		242			,,

		Exhibit R-	2a, RDT&I	E Project .	Justificatio	on				February 2	2007
	ET ACTIVITY oplied Research				06025	IBER AND TITL DOF MULTI-I E TECH	E DISCIPLINAI		OJECT NUMBE 23 Laser & I	R AND TITLE	ice Tech
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
5023	Locar & Imaging Space Tech	Actual 7.701	Estimate 0.000	Estimate 0.000	Estimate 0.000	Estimate 0.000	Estimate 0.000	Estimate 0.000	Estimate 0.000	Complete	TBD
3025	Laser & Imaging Space Tech Quantity of RDT&E Articles	/./01	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	
Note:	In FY 2007, efforts transfer to PE 06	ů	ş	÷	ů	0	ş	Ů	÷	effectively m	anage
	rovide oversight of the efforts.	020001,2000	tee Energy 1	, i i i i i i i i i i i i i i i i i i i			.88 ~ Pare 1	,	01401 00 111010		unage
]	A. Mission Description and Budget Develop advanced, long-range, optica pointing; large, lightweight optics; and weapons, as well as low-power imagin	l technologies d optical coatin ng systems.	such as advanngs that suppo		-	•	•		-	-	
(U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop advance control; beam acquisition, tracking, an lightweight optics; and optical coating greatly extend the range of high-powe	ed, long-range, nd pointing; ac gs that support er laser weapor	optical techno laptive optics; relay mirror s 1s, as well as l	dual line-of-s ystems. Relay ow-power ima	ight pointing; y mirror syster aging systems.	large, ns can	<u>FY 20</u> 5.7 <sup>,</sup>		<u>7 2007</u> 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U)	In FY 2006: Investigated two-beam p control devices for both monolithic ar In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		-	-							
(U) (U)	MAJOR THRUST: Assess the vulner maintain and update catalogued satell In FY 2006: Assessed the survivabili high-energy laser and other directed e improvement of predictive avoidance performance of Laser Clearinghouse f catalogued satellites. Enhanced and r models for space systems that will ena estimate of on orbit space systems cap assessment methodology by anchoring algorithms and hardware for rapidly c	ites. ty and vulnera nergy systems analyses and p functions. Up efined finite st able rapid char babilities for ir g modeling too	bility of aeros . Updated res provided data dated previous ate modeling racterization o nproved space ols to empirica	pace systems ponse databas to U.S. Strateg ly completed process, physi f new launche situational av l data. Incorp and new launc	to the effects of ses for continu- gic Command assessments of ical, and functions and provide wareness. Upp porated improv	of ed for the n ional a better lated red nt data	1.9	05	0.000	0.000	0.000
Proje	ect 5023				Line Item No. 10 Page-3 of 21 243	J				Exhibit R-2a (P	E 0602500F)

	Exhibit	: R-2a, RD1	<b>&amp;E Projec</b>	t Justifica	ation			DATE	February	2007
UDGET ACTIVITY 2 Applied Research				060	NUMBER AND TI 2500F MULTI ACE TECH			PROJECT NUMB 5023 Laser &		ace Tech
<ul> <li>U) <u>B. Accomplishments/Planned I</u> fusion workstations needed for s</li> <li>U) In FY 2007: Not Applicable.</li> </ul>			e space situati	onal awarenes	ss mission.	<u>FY 20</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul><li>J) In FY 2008: Not Applicable.</li><li>J) In FY 2009: Not Applicable.</li><li>J) Total Cost</li></ul>						7.7	701	0.000	0.000	0.000
U) <u>C. Other Program Funding Su</u>	•								_	
	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimat		Cost to Complete	
<ul> <li>J) Related Activities:</li> <li>J) PE 0602605F, Directed Energy Technology.</li> <li>J) PE 0603444F, Maui Space Surveillance Systems.</li> <li>J) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.</li> <li>J) PE 0603605F, Advanced Weapons Technology.</li> <li>J) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>D) Accuricitien Structure</li> </ul>										
J) <u>D. Acquisition Strategy</u> Not Applicable. Project 5023				R-1 Line Item N Page-4 of 2					Exhibit R-2a (	PE 0602500

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY pplied Research				06025	IBER AND TITL 00F MULTI-I E TECH			ROJECT NUMB 025 Space M	ER AND TITLE aterials Dev	elopment
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
5025		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	TDD
5025	Space Materials Development Quantity of RDT&E Articles	19.197	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Note:	In FY 2007, efforts transfer to PE 00	÷	Ŷ	ů	ů.	Ŷ	*	ŷ	Ĵ		L
effort		5021021, Mate	fiais, i foject c	21001, Space		velopment, m			nanage and pr	ovide oversign	it of the
	This project develops the materials ar current and future Air Force space sys composites, and nonmetallic composi Rocket propulsion materials developr high-temperature protection materials resistant to meet space and ballistic m systems and subsystems for space and	stems. Familie tes to provide nent in this pro- are being deven sissile requiren	es of affordable new capabilitie ject supports eloped that are nents. Materia	e lightweight es for spaceer the Integrated e affordable, li ils technologie	materials are b aft, ballistic m High Payoff I ightweight, dir	being develope issile, and pro Rocket Propuls mensionally st	ed, including r pulsion syster sion Technolo able, thermall	netals, polym ns to meet th gy (IHPRPT) y conductive	ers, ceramics, e future space program. Ac and/or ablation	metallic requirements. lvanced on and erosion	
(U)	<b>B. Accomplishments/Planned Prog</b>	ram (\$ in Mill	ions)				<u>FY 20</u>	06 F	Y 2007	<u>FY 2008</u>	FY 2009
	MAJOR THRUST: Develop materia			ally improve p	performance, d	lurability,	10.8		0.000	0.000	0.000
	and cost of rocket propulsion systems	-			· ·						
	In FY 2006: Evaluated suitability of casings, insulation, nozzle throats, an and tested in representative rocket en material behavior in rocket combustions spacecraft propulsion components. A materials. Evaluated processes for so sizes. Demonstrated innovative conc Characterized material candidates, and chambers, nozzles, and catalysts.	d spacecraft pr gine environm on environmen /alidated mater cale-up from co cepts and techn	opulsion appli ent to validate t for solid rock tials performan oupon-level tes ologies that co	ications. Fabr materials per ket nozzles, ex- nce goals for o sting to more puld enable ne	ricated subscal formance. An xit cones, throa direct replacen complex shape w engine desig	e articles alyzed ats, and nent of es and gns.					
	In FY 2007: Not Applicable.										
	In FY 2008: Not Applicable. In FY 2009: Not Applicable.										
(U) (U)	m r i 2007. Not Applicable.										
(U)	MAJOR THRUST: Develop afforda processing technologies for Air Force			non-structura	l materials and	I	6.7	77	0.000	0.000	0.000
Proje	ect 5025				Line Item No. 1 Page-5 of 21	0				Exhibit R-2a (P	PE 0602500F)
					245						

	Exhibit R-2	2a, RDT&E Projec	t Justificat	ion			DATE	February	2007
	GET ACTIVITY pplied Research		0602	JMBER AND TIT 2500F MULTI- CE TECH	TLE -DISCIPLINAI		ROJECT NUMB D25 Space M		velopment
(U) (U) (U) (U) (U)	<b>B.</b> Accomplishments/Planned Program (\$ in Milli In FY 2006: Developed candidate metallic systems robust high-temperature, long duration cruise or accomethods to understand behavior of materials in cryo compatibility research results through integrated tech Aeronautics and Space Administration (NASA). De systems for leading edges, nosetips, and aeroshells f applications. Demonstrated oxidation-protected card high-speed vehicle applications. Developed advance and dimensionally stable structural space application and micro-electro-mechanical systems devices for m Evaluated candidate space materials and collected cri In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	for thin gage structures f ess to space environment genic environments and a hnical working groups w eveloped subscale high-te for expendable and reusab bon-carbon materials in e ed composite technologie ns. Developed wear-resis noving mechanical assem	ts. Refined ana analyzed liquid with industry and emperature pro- ble high-speed environments re- es for thermal r stant materials, ablies on spaced	lytical l oxygen d National tection vehicle elevant to management lubricants, craft.	<u>FY 20</u>	<u>06 F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U) (U)	MAJOR THRUST: Develop materials and materials performance and affordability of surveillance, tracki In FY 2006: Demonstrated electro-optic polymers f frequency (RF) system control architectures. Explor and architecture development for very long wavelen Developed materials and materials process technolog communication system apertures. In FY 2007: Not Applicable. In FY 2008: Not Applicable.	ing, targeting, and situation for optical communication red processes to allow ad light alternative materials	onal awareness ns, data links, a lvanced materia operating at 40	s systems. and radio als design ) Kelvin.	1.5	21	0.000	0.000	0.000
(U) (U)	In FY 2009: Not Applicable. Total Cost				19.1	97	0.000	0.000	0.000
(U) (U)		Y 2007 FY 2008 Estimate Estimate	<u>FY 2009</u> <u>Estimate</u> R-1 Line Item No. Page-6 of 21	<u>FY 2010</u> <u>Estimate</u> 10	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u> Exhibit R-2a (I	-

Exhibit R-2a, RDT&E Pr	oject Justification	DATE
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	February 2007 T NUMBER AND TITLE pace Materials Development
<ul> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> <li>(U) PE 0603112F, Advanced Materials for Weapon Systems.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>		
Project 5025	R-1 Line Item No. 10 Page-7 of 21 247	Exhibit R-2a (PE 0602500F

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
BUDGET ACTIVITY 02 Applied Rese	earch				06025	IBER AND TITL 00F MULTI-I E TECH	LE DISCIPLINA	RY 50	OJECT NUMBE 26 Rocket P ech		Component
Co	ost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5026 Rocket Pr Tech	ropulsion Component	48.113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity	of RDT&E Articles	0	0	0	0	0	0	0	0		
<ul> <li>provide oversight of this Project to PE (</li> <li>(U) <u>A. Mission I</u> This project of emphasis are novel space p future space a manufacturing</li> </ul>	, efforts transfer to PE 06 of the efforts. Funds for 0602203F, Aerospace Pro Description and Budget develops advances in rock propellants, propellant n propulsion concepts. Tec and missile launch subsyster the the the transfer of the transfer of the transfer of the propulsion on the transfer of the transfer of the transfer of the propulsion concepts. Tec and missile launch subsyster the transfer of the transfer of the transfer of the transfer of the transfer of the transfer  the 2007 Cong opulsion, Proje <b>Item Justifica</b> ket propulsion nanagement, co hnologies of in stems. Technologies in this project	ressionally-di ect 6233SP, Sp technologies ombustion, roo nterest will im ologies are dev	rected Engine pace Rocket C for space acce cket material a prove reliabil veloped to red	eering Tool Im Component Tec ess, space man applications, T ity, performan uce the weight	provement Pro- chnology, for o euver, and bal cechnology for ce, survivabilit t and cost of c	ogram (ETIP) execution. llistic missiles r Sustainment ity, affordabili components us	in the amount . Analytical a of Strategic S ity, and enviro ing new mater	t of \$2.8 millio and experimen systems (TSSS ponmental comp rials and impro	on were move tal areas of ) Phase 1, and patibility of oved designs a	d from d and	
(U) MAJOR TH reduced-toxi synthesis me high-energy- paths for inc and demonst bipropellants IHPRPT pro	<b>ishments/Planned Prog</b> RUST: Develop, charact city monopropellants to i ethods. Efforts include ev- density oxidizers, nano-r orporating these material rator engine evaluations. s that reduce the cost of s gram phases.	erize, and test increase space valuation and d naterials, catal s into propella Efforts seek r pace access an	advanced hyd launch payloa levelopment o yst, and polyr nts; and for se nonopropellar d space opera	d capability a f reduced-tox neric binders; lected propell nts with perfor tions. Phases	nd refine new icity ionic salt determining o lants perform l rmance equiva are referring t	, ptimized aboratory lent to	<u>FY 20</u> 3.4		<u>Y 2007</u> 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
energy-densi determine m initial solid p address abla	Downselected potential ity materials candidates. aterials compatibility and propellants ingredients in tion effects on laser-prop opulsion concepts with er	Evaluated pro l performance to Phase III so elled lightcraft	pellants in adv and prepare fo lid propellant t fuel and fuel	vanced combu or large-scale formulations. system. Mod	istion devices t motor tests. In Completed et leled and analy	ncorporated fforts to vzed					
	Not Applicable.										
Project 5026				R-1	Line Item No. 1	0					

	Exhibit R-2a, RDT&E Project Ju	stification		DATI	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DIS SPACE TECH	SCIPLINARY		ABER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	MAJOR THRUST: Develop advanced liquid engine combustion technology for in while preserving chamber lifetime and reliability needs for engine uses in heavy life Efforts include modeling and analyzing advanced propulsion concepts with enhance reliability such as aerovehicles and potential launch systems. Phases are referring program phases.	t space vehicles. red performance and	7.900	0.000	0.000	0.000
(U)	In FY 2006: Characterized, studied, and evaluated shear coaxial injector performat chamber/injector compatibility and prevent damage to upper stage engines. Devel enhance the thermal management of upper stage engines for better performance, cl reliability. Analyzed and tested causes and issues that lead to combustion instabilit fueled liquid rocket engines reducing the need for conducting large numbers of cost component and engine tests. Developed advanced synthetic hydrocarbon fuels to re-	oped experiments to namber life, and ty in hydrocarbon stly full-scale				
• •	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U) (U)	MAJOR THRUST: Develop advanced material applications for lightweight comp property enhancements for use in advanced combustion devices and propulsion systems.		5.147	0.000	0.000	0.000
(U)	In FY 2006: Developed advanced, recyclable, ablative components using nano-rei polymers that are two times better than previously developed materials. Character processing technologies to improve nano-reinforced high temperature polymers an materials. Developed new advanced materials for use with high-energy propellant transition of specific advanced high temperature materials to air and space systems weight and cost, and increase performance. Developed processing methodology for nanocomposites for liquid rocket engine tanks.	ized and developed d carbon-carbon s. Completed to reduce system				
(U)	In FY 2007: Not Applicable.					
	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
	R-1 Lin	e Item No. 10				
Pro	ject 5026 Pag	ge-9 of 21			Exhibit R-2a (I	PE 0602500F)

	Exhibit R-2a, RDT&E Project J	ustification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DI SPACE TECH	SCIPLINARY		IBER AND TITLE t Propulsion (	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop advanced liquid engine technologies for improved increasing life and reliability needs for engine uses in expendable and reusable l	-	19.189	0.000	0.000	0.000
(U)	In FY 2006: Developed advance modeling and simulation tool for advanced cry upper stage technologies. Designed hardware for advanced cryogenic upper stage turbopumps and thrust chambers. Evaluated second set of potential hydrocarbon adjust/modify/develop fuel characterization test rig. Developed second concept for liquid rocket engines.	ge technologies - n fuels and				
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advance	ed propulsion	4.219	0.000	0.000	0.000
	technologies for stationkeeping, repositioning, and orbit transfer for large comm					
	microsatellites, and satellite constellations. Phases are referring to the IHPRPT					
(U)	In FY 2006: Completed initial development and test of monopropellant thruster	-				
	combustion sustainment component technologies for chemical-based space prop	-				
	Phase II lifetest and evaluated Phase III plasma thrusters for microsatellites prop	ulsion systems.				
	Completed development and test of a controlled solid propellant.					
	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U) (U)	CONGRESSIONAL ADD: Engineering Tool Improvement Program (ETIP).		4.168	0.000	0.000	0.000
(U)	In FY 2006: Provided additional modeling and simulation tool development for	Hall-effect thruster	4.108	0.000	0.000	0.000
(0)	physical models, improvements to the ROCket Engine Transient Simulation (RC					
	interface, and added rocket-based combined cycle models to the Integrated Prop					
	code for future fully reusable launch vehicle concepts. Added capability to anal	-				
	concepts such as Field Reversed Configuration.					
(U)	In FY 2007: Not Applicable.					
	In FY 2008: Not Applicable.					
	R-11	_ine Item No. 10				
		age-10 of 21			Exhibit R-2a (F	

Exhibit R-2a, RDT&E Project Just	tification		DATE	February	2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TI 0602500F MULT SPACE TECH			IBER AND TITLE t Propulsion	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>					
(U) CONGRESSIONAL ADD: Universal Small Launch Vehicle		4.070	0.000	0.000	0.000
(U) In FY 2006: Integrated propellant tanks with clusters of axi-symmetric aero-spike en nozzles to gain increases in mission performance by employing a vortex combustion oxygen/methane rocket engine concept. This technology could be used on highly op reusable space transportation systems.	, cold-walled liquid				
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) Total Cost		48.113	0.000	0.000	0.000
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>					
<u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2</u>	009 <u>FY 2010</u>	<u>FY 2011</u> <u>FY 201</u>	<u>2</u> <u>FY 201</u>	<u>3</u> <u>Cost to</u>	Total Cost
	mate <u>Estimate</u>	Estimate Estimate	ate <u>Estima</u>	te <u>Complet</u>	<u>e</u>
(U) Related Activities:					
(U) PE 0601102F, Defense					
Research Sciences.					
(U) PE 0602114N, Power					
Projection Applied Research.					
(U) PE 0602203F, Aerospace					
Propulsion. (U) PE 0602303A, Missile					
Technology.					
(U) PE 0602805F, Dual Use					
Science and Technology.					
(U) PE 0603216F, Aerospace					
Propulsion and Power					
Technology.					
(U) PE 0603500F,					
Multi-Disciplinary Adv Dev					
Space Technology.					
	Item No. 10				
	11 of 21 251			Exhibit R-2a (	PE 0602500F)

Exhibit R-2a, RDT	&E Project Justification	DATE February 2007
UDGET ACTIVITY 2 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5026 Rocket Propulsion Componen Tech
<ul> <li>U) <u>C. Other Program Funding Summary (\$ in Millions)</u></li> <li>U) This project has been</li> </ul>		
coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.		
<ul> <li>U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>		
Project 5026	R-1 Line Item No. 10 Page-12 of 21	Exhibit R-2a (PE 0602500f

High Speed A TechQuantity of RQuantity of RNote: In FY 2007, effeprovide oversight of th(U) A. Mission DescThis project deve short-term focus scramjet powered interest to both th component devel	(\$ in Millions) Airbreathing Prop RDT&E Articles forts transfer to PE 0	Item Justifica airbreathing, hy ieled engines ca	tion personic prop	FY 2008 Estimate 0.000 0 on, Project 6	06025 SPAC FY 2009 Estimate 0.000	E TECH FY 2010 Estimate 0.000	FY 2011 Estimate 0.000		OJECT NUMBE 27 High Spe ch FY 2013 Estimate 0.000		ning Prop Total TBD
High Speed A TechQuantity of RQuantity of RNote: In FY 2007, effeprovide oversight of th(U) A. Mission DescThis project deve short-term focus scramjet powered interest to both th component devel	Airbreathing Prop <u>RDT&amp;E Articles</u> forts transfer to PE 0 he efforts. cription and Budget elops revolutionary, is on hydrocarbon fu d engines that can en	Actual 0.239 0 502203F, Aeros <b>Item Justifica</b> airbreathing, hy ieled engines ca	Estimate 0.000 0 space Propulsi tion personic prop	Estimate 0.000 0	Estimate 0.000 0	Estimate 0.000 0	Estimate 0.000 0	Estimate 0.000	Estimate 0.000	Complete	
Tech         Quantity of R         Note:       In FY 2007, effe         provide oversight of th       (U) <b>A. Mission Desc</b> This project deve         short-term focus       scramjet powered         interest to both th       component devel	RDT&E Articles forts transfer to PE 0 he efforts. cription and Budget elops revolutionary, i is on hydrocarbon fu d engines that can en	0.239 0 502203F, Aeros <b>Item Justifica</b> airbreathing, hy ieled engines ca	0.000 0 space Propulsi tion ypersonic prop	0.000	0.000	0.000	0.000	0.000	0.000		TBD
<ul> <li>Note: In FY 2007, efference</li> <li>provide oversight of the</li> <li>(U) <u>A. Mission Desc</u></li> <li>This project deversion</li> <li>short-term focus</li> <li>scramjet powered</li> <li>interest to both the</li> <li>component devel</li> </ul>	forts transfer to PE 0 he efforts. cription and Budget elops revolutionary, is on hydrocarbon fu d engines that can en	<b>Item Justifica</b> airbreathing, hy ieled engines ca	space Propulsi tion personic prop		, v	*	÷	0	0		
<ul> <li>Note: In FY 2007, efference</li> <li>provide oversight of the</li> <li>(U) <u>A. Mission Desc</u></li> <li>This project deversion</li> <li>short-term focus</li> <li>scramjet powered</li> <li>interest to both the</li> <li>component devel</li> </ul>	forts transfer to PE 0 he efforts. cription and Budget elops revolutionary, is on hydrocarbon fu d engines that can en	Item Justifica airbreathing, hy ieled engines ca	tion personic prop	on, Project 6	233SP, Space	Rocket Compo			0		
	lopment, and ground	fense and the N	Mach number	ating over a b rs to achieve	broad range of access to space	flight Mach nu e. Technologi	dable, on dema umbers and lo es developed t	and access to a nger term focu under this prog	space for the A us will be on h gram enable ca	Air Force. The ydrogen fuele apabilities of	2
<ul> <li>(U) MAJOR THRUS cycle engines (C the development</li> <li>(U) In FY 2006: Con</li> </ul>	ot Applicable. ot Applicable.	nents, system d cycle airbreathi mand access to e studies to dete	esign trades, a ng hypersonic space vehicle ermine military	propulsion to to meet futto y payoff and o	echnologies in ure warfighter establish comp	support of needs. onent	<u>FY 20</u> 0.2. 0.2.	39	<u>7 2007</u> 0.000 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
							0.2		0.000	0.000	0.000
<ul> <li>(U) <u>C. Other Progra</u></li> <li>(U) Related Activities</li> <li>(U) PE 0601102F, De Research Science</li> <li>(U) PE 0602201F, Ae</li> </ul>	es: efense es.	<u>Y 2006</u> <u>F</u>	<u>Y 2007</u> <u>F</u>	Y 2008 Estimate	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u>	FY 2011 Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Project 5027					Line Item No. 1 Page-13 of 21	0					

Exhibit R-2a, RDT&F	E Project Justification	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5027 High Speed Airbreathing Prop Tech
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
<ul><li>Flight Dynamics.</li><li>(U) PE 0602203F, Aerospace Propulsion.</li></ul>		
(U) PE 0602602F, Conventional Munitions.		
(U) PE 0602702E, Tactical Technology.		
<ul><li>(U) PE 0603111F, Aerospace Structures.</li></ul>		
<ul> <li>(U) PE 0603216F, Aerospace</li> <li>Propulsion and Power</li> <li>Technology.</li> </ul>		
<ul><li>(U) PE 0603601F, Conventional Weapons Technology.</li></ul>		
<ul> <li>(U) Program is reported to/coordinated by the Joint Army/Navy/NASA/Air Force (JANNAF) Executive Committee.</li> </ul>		
<ul> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>		
(U) <u><b>D. Acquisition Strategy</b></u> Not Applicable.		
Project 5027	R-1 Line Item No. 10 Page-14 of 21	Exhibit R-2a (PE 0602500F)

		Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on			DATE	February	2007		
	ET ACTIVITY oplied Research				06025	IBER AND TITL 00F MULTI-I E TECH	LE DISCIPLINA	ARY 5028 Space Sensors, Photonics & RF Proc					
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total		
	Space Sensors, Photonics & RF	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete			
5028	Proc	1.848	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD		
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0				
06026 (U) <u>4</u> 1 f s	. Funds for the 2007 Congressionally 01F, Space Technology, Project 6288 <b>A. Mission Description and Budget</b> This project focuses on developing me or RF space sensor applications. The ensors based in space. The project an dissipation, higher reliability, and imp ffordable and reliable space surveilla	809, Spacecraf Item Justifica ethods of gene e enabling tech ms to demons roved perform	t Vehicle Tech tion rating, control nologies will trate significat tance. This pr	ling, receiving be used for in htly improved oject also dev	xecution. g, transmitting telligence, sur military space	, and processi veillance, reco e sensors of sr	ing photonic, c onnaissance, e naller size, lov	optical, and op lectronic warf ver weight, lo	oto-electronic fare, and precisiver cost, lower	(mixed) signa sion engagem er power	ls		
	B. Accomplishments/Planned Prog		-				FY 20	06 F	Y 2007	<u>FY 2008</u>	FY 2009		
	MAJOR THRUST: Study adaptive p			ge, multi-miss	ion, space-bas	ed	<u>1 1 20</u> 1.0		0.000	0.000	0.000		
(U) 1 (U) 1	conformal arrays. In FY 2006: Developed adaptive pro- computing architectures for multi-inte- sensing from space-based platforms. waveform techniques for a space surv in FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable. MAJOR THRUST: Develop advance focuses on improving performance and Note: In FY 2006, photonics technolo- his Project. In FY 2006: Developed and demonst delay for wideband phased array appl in FY 2007: Not Applicable.	elligence intell Studied signal eillance platfo e photonic con d reducing siz ogy efforts mo rated photonic	igence, survei processing m rm. ponent techno e, mass, and p wed into this t	llance, and rec ethods and no plogy for spac rime power. hrust from pre	connaissance ( ovel adaptive tr e-base sensors Supports ISR evious major th	(ISR) ransmit s that capability. hrusts in	0.8	48	0.000	0.000	0.000		
Proje	ct 5028				Line Item No. 1 Page-15 of 21 255	0				Exhibit R-2a (F	PE 0602500F)		

	Exhibit	: R-2a, RD	Γ&E Projec	ct Justifica	tion			DATE	February	2007
BUDGET ACTIVITY D2 Applied Research				0602	UMBER AND TI 2500F MULTI CE TECH		RY	PROJECT NUMB 5028 Space S RF Proc	ER AND TITLE	
(U) <b>B. Accomplishments/Planned</b> (U) In FY 2008: Not Applicable.	Program (\$ in	<u>Millions)</u>				<u>FY 2</u>	006	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
<ul><li>U) In FY 2009: Not Applicable.</li><li>U) Total Cost</li></ul>						1.8	348	0.000	0.000	0.000
(U) <u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u>	<u>fillions)</u>								
	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>		<u>Cost to</u> <u>Complete</u>	
<ul> <li>(U) Related Funding:</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0603203F, Advanced Aerospace Sensors.</li> <li>(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <b>D. Acquisition Strategy</b> Not Applicable.</li> </ul>										
Project 5028				R-1 Line Item No Page-16 of 21					Exhibit R-2a (F	PE 0602500F
			I	256 JNCLASSIF					·	

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
					06025	00F MULTI-D					Tech
Exhibit R*22, RD1 & Project Justification         February 2007           BUDGET ACTIVITY         Cost (S in Millions)         F2 2006         FY 2007         FY 2007         FY 2007         FY 2007         FY 2011         Fy 2012         Fy 2012         Fy 2013         Cost (S in Millions)         FY 2006         FY 2007         FY 2007         FY 2011         FY 2012         FY 2012         FY 2013         Cost (S in Millions)         FY 2006         FY 2010         FY 2012         FY 2017         FY 2017		Total									
										1	
5029										Continuing	TBD
		ŷ	Ş	÷	÷	ů	ŝ	ţ	ţ		
		502204F, Aero	space Sensors	, Project 6244	SP, Space Sen	isors, in order	to more effect	tively manage	e and provide	oversight of th	e
effort	tS.										
	This project focuses on developing pr develops the baseline technologies rec situational awareness. Through mode	ocesses and tec quired to mana	chniques for el ge and perforr	n on-board sp	ace sensor info	ormation fusio	on for timely a	nd comprehe	ensive commun	nications and	
(U)	<b>B.</b> Accomplishments/Planned Prog	<u>ram (\$ in Mill</u>	<u>ions)</u>				<u>FY 20</u>	<u>06 F</u>	Y 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U)	MAJOR THRUST: Develop space-q	ualified precis	ion time, posit	tion, and velo	city sensors ca	pable of	0.3	39	0.000	0.000	0.000
	operating in jamming environments e	nabling multip	le platform se	nsor-to-shoot	er operations.	Note: In					
	-										
			-	-							
		-		• •	-						
	-	ques in terms o	f measures of	performance	and warfighter	r utility.					
	In T 2009. Not Applicable.										
	MAJOR THRUST: Develop advance	ed active phase	d arrav antenr	na subsystems	to meet the u	nique	0.7	35	0.000	0.000	0.000
	-	-	-	-		-					
	intelligence, surveillance, and reconn	aissance capab	ility.	-							
(U)	In FY 2006: Developed low-mass sh	allow-depth m	icrowave ante	nna panels wi	th integrated a	ctive					
	elements and low RF distribution loss	s.									
	**								0.000	0.000	0.000
(U)	Total Cost						1.0	/4	0.000	0.000	0.000
Proje	ect 5029				Line Item No. 10 Page-17 of 21	0				Exhibit R-2a (P	E 0602500F)
					257						

	Exhibi	t R-2a, RD	F&E Projec	ct Justific	ation			DATE	-ebruary 2007		
BUDGET ACTIVITY 02 Applied Research				06	NUMBER AND TI 02500F MULT PACE TECH			PROJECT NUMBER AND TITLE 5029 Space Sensor & CM Tech			
(U) <u>C. Other Program Funding S</u>	ummary (\$ in N	<u>(Iillions)</u>									
	FY 2006 Actual	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> Complete Total Cost		
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0603203F, Advanced Aerospace Sensors.</li> <li>(U) PE 0603500F, Multi-Disciplinary Adv Dev Space Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>											
Project 5029				R-1 Line Item Page-18 of					Exhibit R-2a (PE 0602500F)		
			_	258							

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
Exhibit R-2a, KD1&E Project Justification           BUDGET ACTIVITY         PROJECT           02 Applied Research         PROJECT         PROJECT           S02 Optical Research         SPACE TECH         5082 Optical Networking Tech         11.588         0.000         0.0		CT NUMBER AND TITLE Optical Networking Tech									
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	· · · · ·								Estimate	Complete	
5082										Continuing	TBD
NT /			0		÷	ő	÷		0		
			nand Control	and Commun	ications, Proje	ect 6266SP, Sp	ace Optical N	letwork Tec	nnology, in ord	er to more effe	ectively
	between platforms. As the application communications capacities are thousa emerging communication and informa- scale optical Code Division Multiple A benefits associated with the advanced echnology to integrate current Radio software to support them. These technology	n of laser-based nds of times gr tion technolog Access (CDMA fiber optic, wi Frequency wit nologies have p	d, point-to-poi reater than cur gies, for applic A) and Wavele reless, platfor h high data ra potential appli	nt communica rent commun ations in air a ength Division m, and satellit te Optical LA cations in spe	ations between ications satelli and space. Thi in Multiplexed te networks that SER communi- scific military s	a satellites ema tes, become a s project will (WDM) transa at can be built ications, along systems includ	erges, air and realistic possi explore techno ceivers and pr from them. T g with network ling reliable, h	space-based bility. This blogies for in ototype network this project with a management high bandwing	optical networ project will ass nplementing pl vorks, built to d will develop an nt techniques, t dth, jam-resista	ks, whose sess and adapt hotonic chip lemonstrate the d demonstrate sools and nt	the
(U) (U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop and asse environment. In FY 2006: Designed and developed redundancy, fault tolerance, self-routi networks. Demonstrated a highly inte	<b>cam (\$ in Mill</b> ess optical netv l a multi-path i ng and non-blo	ions) vork technolo nterconnectio ocking switch	gies for applic n network tha ing required fo	cation in the sp t provides for or air and spac	e-based	<u>FY 20</u>	06		<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U) (U) (U) (U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable. MAJOR THRUST: Develop and asso schemes and protocols for use in space	e-based optica	l networks.				2.9	26	0.000	0.000	0.000
	In FY 2006: Demonstrated industry s airborne platforms. Designed and dev protocols for applicability to air and s	veloped optical	l burst switchi	ng and optica . Performed a	l label switchin a flight demon	ng stration of					
Proje	ct 5082				Line Item No. 10 Page-19 of 21	0				Exhibit R-2a (P	E 0602500F)
<u> </u>					259					· · · ·	

Exhibit R-2a, RDT&E Project Ju	stification		DATE		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TIT 0602500F MULTI SPACE TECH		February 200 PROJECT NUMBER AND TITLE 5082 Optical Networking Tec		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	1.0	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
industry standard single mode optical communications bus interface chip for airbo (U) In FY 2007: Not Applicable.	orne platforms.				
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
<ul> <li>(U) MAJOR THRUST: Develop and demonstrate heterogeneous, seamless, secure, secure are capacity air/space/surface wireless networks that integrate current RF with high decommunications.</li> </ul>		4.050	0.000	0.000	0.000
(U) In FY 2006: Designed and developed waveform, coding, management, and atmostechnologies for a combined RF/laser communications brassboard. Characterized industry standard single mode optical communications bus for airborne platforms air-to-ground RF and laser networked communication.	and developed an				
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>					
(U) CONGRESSIONAL ADD: Space Qualification of the Common Data Link.		3.102	0.000	0.000	0.000
(U) In FY 2006: Modified the Common Data Link (CDL), previously developed for J Target Attack Radar System, U-2, Global Hawk, and Airborne Warning and Cont performed qualifications testing for operation in the space environment. Enhance capabilities by developing higher throughput space qualifiable terminals to enable CDL terminals to receive direct downlinks for space borne assets	trol System, and ed current CDL				
(U) In FY 2007: Not Applicable.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.			0.0		
(U) Total Cost		11.589	0.000	0.000	0.000
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>					
	<u>Y 2009 FY 2010</u> Estimate Estimate	FY 2011FY 20EstimateEstim		<u>Cost to</u> <u>Complet</u>	
(U) PE 0602702F, Command,	<u>Istiniate</u>	<u>Estimate</u> Estim			¥
Control, and Communications.					
	ne Item No. 10				
	ge-20 of 21			Exhibit R-2a (	PE 0602500F)
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Exhibit R-2a, RDT&E P	roject Justification	DATE February 2007
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602500F MULTI-DISCIPLINARY SPACE TECH	PROJECT NUMBER AND TITLE 5082 Optical Networking Tech
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
J) PE 0603789F, C3I Advanced		
Development.		
J) This project has been coordinated through the		
Reliance 21 process to		
harmonize efforts and		
eliminate duplication.		
U) <b>D. Acquisition Strategy</b> Not Applicable.		
	R-1 Line Item No. 10	
Project 5082	Page-21 of 21	Exhibit R-2a (PE 0602500

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#### PE NUMBER: 0602601F PE TITLE: Space Technology

	Exhibit R-2, RDT&E Budget Item Justification									DATE February 2007	
	UDGET ACTIVITY       PE NUMBER AND TITLE         2 Applied Research       0602601F Space Technology										
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	103.604	103.472	109.566	106.755	123.509	123.927	125.251	128.550	Continuing	TBD
1010	Space Survivability & Surveillance	47.152	48.567	43.484	46.991	46.119	46.968	48.596	49.893	Continuing	TBD
4846	Spacecraft Payload Technologies	16.314	17.150	22.949	21.877	24.050	24.224	25.181	25.755	Continuing	TBD
5018	Spacecraft Protection Technology	2.129	1.923	2.548	3.503	3.831	3.840	4.657	4.754	Continuing	TBD
8809	Spacecraft Vehicle Technologies	38.009	35.832	40.585	34.384	49.509	48.895	46.817	48.148	Continuing	TBD

Note: Funds for the FY 2007 Congressionally-directed Integrated Control for Autonomous Space Systems in the amount of \$1.6 million were moved from PE 0602500F, Multi-Disciplinary Space Technology, Project 625028, and funds for the Center for Solar Electricity and Hydrogen in the amount of \$3.6 million were moved from PE 0602203F, Aerospace Propulsion, Project 6233SP, to this PE for execution. Also, funds for the FY 2007 Congressionally-directed Space-Qualified Common Data Link in the amount of \$2.2 million were moved from this PE to PE 0602702F, Command, Control and Communications, Project 6266SP, for execution.

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

This PE focuses on four major areas. First, space environmental protection develops technologies to understand, mitigate, and exploit effects of weather and geophysics environments on the design and operation of Air Force systems. Second, spacecraft payload technologies improve satellite payload operations by investigating advanced component and subsystem capabilities. Third, spacecraft protection develops technologies for protecting U.S. space assets in potential hostile settings. The last major area, spacecraft vehicles, focuses on spacecraft platform, payload, and control technologies, and their interactions. Note: In FY 2007, Congress added \$1.0 million for Elastic Memory Composites, \$1.1 million for Three Dimensional Deployable Structure Systems for Space, \$0.3 million for Shielding Rocket Payloads, \$1.0 million for Multicontinuum Technology for Space Structures, \$1.1 million for Deployable Structures Experiment, \$1.0 million for Field Programmable Gate Array, \$1.0 million for Flexible CIGS Solar Cells on Silicon Substrates for Spacecraft, \$3.2 million for High-frequency Active Auroral Research Program (HAARP), \$1.0 million for Joint Micro Power Initiative, \$1.1 million for Nanoscale Microelectronic Circuit Technology Development, \$1.3 million for USAF National Security Research - Signature, and \$2.2 million for Space-Qualified Common Data Link. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary space technologies.

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Exhibit R-2, RDT&E Budg	et Item Justification		DATE Februa	ry 2007							
BUDGET ACTIVITY <b>2 Applied Research</b>	PE NUMBER AND TITLE 0602601F Space Technolo	ogy									
U) <u>B. Program Change Summary (\$ in Millions)</u>											
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>							
U) Previous President's Budget	104.392	85.594	114.195	129.471							
U) Current PBR/President's Budget	103.604	103.472	109.566	106.755							
U) Total Adjustments	-0.788										
U) Congressional Program Reductions		-0.015									
Congressional Rescissions	-0.017	-0.392									
Congressional Increases		15.285									
Reprogrammings	0.680	3.000									
SBIR/STTR Transfer	-1.451										
U) <u>Significant Program Changes:</u>											
Changes to this PE since the Previous President's Budget are due to high	her Air Force priorities.										
C. Performance Metrics											
(U) Under Development.											
(0) Older Development.											

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Page-2 of 24	Exhibit R-2 (PE 0602601F)
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		Exhibit R-	2a, RDT&E	E Project	Justificatio	on			DATE	February 2	2007	
	ET ACTIVITY oplied Research					IBER AND TITL 01F Space T		10		IECT NUMBER AND TITLE  ) Space Survivability & /eillance		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
1010	Space Survivability & Surveillance	47.152	48.567	43.484	46.991	46.119	46.968	48.596	49.893	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0			
T t i s	A. Mission Description and Budget This project develops the technologies pattlespace environment for realistic s includes technologies to specify and f pace-based surveillance operations, a project includes the seismic research p	s to exploit the space system de orecast the env and allow the o	space environ esign, modelin rironment fron pportunity to p	ng, and simula n "mud to sun mitigate or ex	tion, as well a for planning ploit the space	s the battlespa operations an e environment	ace environme d ensuring un for both offer	nt's effect on a interrupted sy	space systems stem performa	' performance. ance, optimize	. It	
(U) ]	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop technologenvironmental conditions hazardous to o improve performance, reduce cost,	ogies for specito to Department	fying, monitor of Defense (D	oD) operation	-	• •	<u>FY 20</u> 4.1		<u>¥ 2007</u> 5.215	<u>FY 2008</u> 6.854	<u>FY 2009</u> 8.649	
	In FY 2006: Developed initial multi- awareness of energetic electron hazar and forecast model with data from ge physical design and accomplished Pre- nigh-resolution solar telescope. Deve and validate solar magnetic field data kinematic and hybrid solar wind mod space plasma and energetic particle se development programs.	ds to space systems osynchronous eliminary Prog eloped autonom from disparate els. Complete ensor concepts	tems. Validat and low-earth ram Design Re nous procedure e network of g d analysis of p and transition	ed dynamic r orbit DoD sat eview of next es to cross cal round-based t oromising mic into spaceflig	adiation belt s tellites. Comp generation, librate, quality telescopes for tro- and nano-t ght hardware	pecification oleted control, use in sechnology						
	In FY 2007: Continue development of situational awareness by coupling to of and forecast capability. Initiate coupl to increase accuracy and lead time. Concluding flares, bursts, and coronal m of radiation belt dynamics.	dynamic radiat ling of radiatio Complete initial nass ejections.	ion belt model n belt model to l predictive mo Develop cono	l to provide da o global geosp odel of solar e cepts for activ	ata-driven spec pace environm explosive even ve beam and w	cification lent models ts, ave probes						
	In FY 2008: Complete detailed analy guidance for operational heliospheric		•		-							
Proje	ct 1010				Line Item No. 1 Page-3 of 24 265	1				Exhibit R-2a (P	E 0602601F)	

	Exhibit R-2a, RDT&E Project	t Justification		DATE	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602601F Space Te	PE NUMBER AND TITLE 0602601F Space Technology			MBER AND TITLE Survivability & e	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> using wide-field radio array. Initiate development of magnetic reconnection a initiation and energy storage. Initiate program to test and evaluate empirical based on synoptic data from Air Force and national observatory assets. Com- energetic electron data assimilation models for real-time situational awareness radiation belt model to provide data-driven specification and forecast capabil radiation belt model to global geospace environment models to increase accu Validate models for ionospheric penetration by very low frequency (VLF) elect their injection into the magnetosphere.	flare prediction models plete development of s by coupling to dynamic ity. Continue coupling of racy and lead time.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Continue measurement of interplanetary magnetic fields using v Complete Spiral 1 magnetic reconnection model to study solar flare initiation Continue program to test and evaluate empirical flare prediction models base Force and national observatory assets. Complete coupling of radiation belt m environment models to increase accuracy and lead time. Utilize three-dimens diffusion models to simulate ultimate global effect of wave-particle interaction electromagnetic wave power injected in narrow altitude slices of radiation be virtual VLF electromagnetic wave generation in the ionosphere and global tra- distribution.	and energy storage. d on synoptic data from Air nodel to global geospace sional global radiation belt ons from VLF lts. Validate models for					
(U) (U)	MAJOR THRUST: Develop spectral signature libraries, target detection tech for application to space-based surveillance, laser weapons, and countermeasu detection of low-observable targets, and targets and space-based resident space Note: In FY 2007, there is an increased emphasis on low-observable target d	re systems, including ce object characterization.	13.882	16.942	13.617	14.236	
(U)	In FY 2006: Developed technologies for visible to infrared wavelength sensi resident space object characterization. Using available airborne and spacebor spectral processing algorithms and related signature databases for remaining data and validated simulations to evaluate candidate sensor technologies for s and area search missions. Developed real-time hypertemporal processing alg optimal parameters for operational system. Improved turbulence forecasting assisted in transition of airborne laser decision aid for testing to operational d Performed case studies on existing and improved stratospheric clear air turbu Addressed decision aid requirements for tactical high-energy lasers and laser	ing for space-to-space rne data, validated daytime terrain classes. Used test spectral theater surveillance gorithms and determine skill, as required, and lecision aid status. lence forecast tools.					
	R	R-1 Line Item No. 11					

	Exhibit R-2a, RDT&E Project Jus	tification		DAT	DATE February 2007		
	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Teo	chnology		UMBER AND TITLE ce Survivability & nce		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>	lahara dari adar d	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Demonstrate technologies for space-based detection, identification and for resident space object characterization, environmental monitoring, and missile was						
	Develop super-resolution techniques for space-based resident space objects for space						
	awareness. Initiate transition of validated spectral processing and exploitation algor						
	signature databases to appropriate users. With available thermal spectral sensors, va	alidate nighttime					
	spectral processing algorithms and related signature databases for specific environment						
	transfer of sensor technologies and architecture concepts to acquisition and operation						
	appropriate. Refine real-time hypertemporal processing algorithms; and continue d						
	optimal parameters for operational system. Develop third generation (model) hyper space. Initiate transition of improved stratospheric clear air turbulence forecast mod	-					
	Weather Agency. Continue to address technology requirements for transition of op-						
	aids for airborne lasers, tactical high-energy laser systems, and laser communication						
(U)	In FY 2008: Finalize real-time hypertemporal (HT) processing algorithms with opt						
	space-based missile launch detection. Continue development of third-generation br						
	for space-based missile launch detection. Begin feasibility study of HT applications						
	intelligence from ground, air, and space-based platforms. Use satellite tracking test						
	Maui Optical and Supercomputing tracking telescopes to demonstrate Space Situati (SSA) capability of HT sensors and validate the utility of this technique to obtain op						
	status of resident space objects. Other advanced sensors of spectral, polarimetric an						
	capabilities are considered in the down selection phase and tested with ground syste	-					
	Complete analysis of space data on real world detections of resident space objects w						
	thermal infrared, visible, and ultraviolet and develop models of sensor performance						
	capability of space-based sensors. Utilize planned space demonstrations to validate	-					
	surveillance and area search missions and supporting models. Continue transition of						
	processing and exploitation algorithms and related signature databases to Governme investigation of spectral applications for material identification in support of militar						
	chemical/biological weapons detection and identification in the thermal infrared and						
(U)	In FY 2009: Finalize brassboard HT sensor for space-based missile launch detectio						
,	real-time HT processing algorithms into sensor platform. Transition brassboard sen						
	customer for space-based missile launch detection. Test feasibility of HT application						
	intelligence from ground, air, and space-based platforms. Define the requirements a	and the optimum					
	R-1 Line	Itom No. 11					

	Exhibit R-2a, RDT&E Project	Justification		DATE	DATE February 2007			
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602601F Space Te			IBER AND TITLE Survivability e			
configuration of a s sensor performance space analyses of se intelligence about s investigation of spe chemical/biological Complete transition databases to Govern space demonstration hyperspectral mode	<b>tts/Planned Program (\$ in Millions)</b> pace-based HT sensor. Develop end-to-end simulation capa models, to assist acquisition community and space operator ensors or sensor suites. The emphasis is on the capabilities to pace objects with signals in all bands and all temporal regin ctral applications for material identification in support of m weapons detection and identification in the thermal infrared of spectral image processing and exploitation algorithms an ament users. Complete analysis and documentation of milit ns of spectral theater surveillance and area search missions. els.	r community in trade to derive information and nes. Continue ilitary d and other bands. nd related signature ary utility of planned	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
improved ionospher	Develop artificial intelligence techniques, forecasting tools ric specification and forecasting, including communications S), space-based geolocation demonstrations, and determina	/navigation outage	7.650	5.615	7.065	7.305		
(U) In FY 2006: Gener scintillation using C battlefield awarenes comparisons betwee measurements to as and tools to track C scintillation. Devel radar/comm applica	ated nowcasts and forecasts of communication/navigation of C/NOFS space and ground system to give the warfighter impose and operational flexibility. Performed metric tests makin, en C/NOFS forecast model and product output parameters a sess effectiveness of scintillation forecasting process. Deve /NOFS forecast metrics to assess military utility of outage v oped technology to produce artificial ionization patches for ations and to mitigate scintillation conditions. Developed sp tions that exploit international network of ionospheric senso	proved space and g standardized and selected available eloped statistical database warning due to use in over-the-horizon pecification and forecast						
into ionospheric spe scintillation warnin models to improve Develop portable io communications/na	m metric tests of C/NOFS scintillation forecasting system. ecification and forecasting algorithms and models for enhan g system. Investigate coupled solar-magnetospheric-ionosp forecast lead times for radar operations, and communication pospheric sensor suite for measuring total electron content a vigation scintillation.	ced military utility of heric-thermospheric ns/navigation outages. and						
(U) In FY 2008: Expan Project 1010	nd high-latitude data collection to initiate a high-latitude scir R-1	ntillation warning system. Line Item No. 11			Exhibit R-2a (I			

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602601F Space Tec	hnology		BER AND TITLE	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Investigate the impact of convection of scintillations to higher latitudes on Ulta communication and Global Positioning System (GPS) navigation systems. Invartificial scintillation generation using the High-frequency Active Auroral Ress Develop portable ionospheric sensor suite for measuring total electron content communications/navigation scintillation. Initiate space radar data collection for compensation study. Develop scintillation mitigation technology by using met Develop techniques of analyzing GPS radio occultation data acquired by C/NC Observing System for Meteorology, Ionosphere and Climate (COSMIC) satell of Kalman filter ionospheric model into forecast models and ionospheric warfi Conduct statistical analysis of neutral density to improve accuracy of empirica for specifying and forecasting neutral density during geomagnetic storms. Improves simpacts of penetration electric fields on generation of equatorial irregula. In FY 2009: Investigate solar activity on enhancement of L-band scintillations the scintillation database and tools to military communication and navigation selectron content and Scintillations over the African subcontinent for better defi scintillation and GPS error environment in the middle-eastern region. Demons mitigation technology using metal-oxide space cloud. Deliver ionospheric corr wide-band radio-frequency waves. Improve modeling techniques for specifyir resolution of neutral density model based on Atmospheric Density Specificati develop physics-based model of the neutral composition, wind, and density. C physics-based 3-D model of equatorial plasma bubbles into warfighter product ionospheric Kalman filter operational models into equatorial models.	vestigate HF induced earch Program (HAARP). and or ionosphere tal-oxide space cloud. DFS and Constellation ites. Begin incorporation ighter impact products. I neutral density models plement algorithm to arities. s to assess the support of systems. Measure total ning the equatorial strate scintillation npensation technique with ng high temporal ation awareness. Improve ion experiment data and Continue transition of				
(U) (U)	MAJOR THRUST: Develop High-frequency Active Auroral Research Progra diagnostic instrument infrastructure.	m site transmitting and	10.000	9.475	9.128	9.942
(U)	In FY 2006: Completed 180-element high frequency transmitter array with 3.0 power capacity.	6 megawatt radiated				
(U)	In FY 2007: Validate performance of 3.6 megawatt transmitting array in Extre	•				
	Frequency/Very Low Frequency (ELF/VLF) wave generation and optical emis					
(U)	In FY 2008: Conduct experimental research with the 3.6 megawatt transmittin	ng array to develop				
Pro	oject 1010	1 Line Item No. 11 Page-7 of 24			Exhibit R-2a (F	PE 0602601F)

	Exhibit R-2a, RDT&E Project Ju	stification		DATI	DATE February 2007				
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602601F Space Te	chnology	PROJECT NUM 1010 Space Surveillanc					
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) techniques to increase the efficiency of ELF/VLF wave generated in space and inic characterize their interactions with charged particles in the earth's radiation belts.	tiate research to	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
	In FY 2009: Continue research to characterize wave-particle interactions and wav in space and their potential application to mitigate charged particle effects on spac operations.	-							
(U) (U)	MAJOR THRUST: Develop basic seismic technologies to support national requir	ements for monitoring	6.849	6.837	6.820	6.859			
(U)	nuclear explosions with special focus on regional distances less than 2,000 kilome In FY 2006: Provided further updated seismic codes for operational use. Focused partition, magnitudes, and source physics moves from hypothesis development tow hypothesis flyoff. Continued efforts on seismic calibration; seismic detection, loca discrimination; and observational studies of seismic wave propagation, including p Focused on transition between local and regional seismic wave propagation and in topics above. Assessed future directions based on results obtained so far.	on seismic energy vards major ation, and propagation in Eurasia.							
U)	In FY 2007: Continue to update seismic codes for operational use. Develop hypo potential discrimination and yield estimation techniques, while addressing unresol for seismic energy partition, magnitudes, and source physics. Incorporate seismic effects into implications for local and regional seismic wave propagation. Continu calibration; seismic detection, location, and discrimination; and observational stud propagation, including propagation in Eurasia. Continue assessment future direction obtained so far.	ved hypothesis issues energy partition le efforts on seismic ies of seismic wave							
(U)	In FY 2008: Test and incorporate new research methods for automated processing numbers of seismic events. Develop long-period regional seismic discrimination, challenges in high-frequency regional discrimination. Continue efforts on seismic detection, location, and discrimination; and observational studies of seismic wave propagation in Eurasia. Conduct comprehensive studies to transition the program local seismic monitoring requirements. Design and conduct theoretical, laboratory support local monitoring.	while examining calibration; seismic propagation, including to meet emerging							
(U)	In FY 2009: Flyoff different techniques for automated processing of increasing nu events. Conduct detailed research on causes of challenges in high-frequency region Further continue efforts on seismic calibration; seismic detection, location, and discussional detailed research on causes of the seismic detection and discussion and the seismic calibration and the seismic detailed research on the seismic detection and the seismic detailed research on the seismi	nal discrimination.							
	ject 1010 Pa	e Item No. 11			Exhibit R-2a (I				

		Exhibit	R-2a, RD	T&E Projec	t Justifica	tion			DATE	February	2007
	GET ACTIVITY Applied Research							1		ER AND TITLE	
(U)	<b>B. Accomplishments/Planned P</b>	Exhibit R-2a, RD1 & Project Justification         ETNITY       PE NUMBER AND TITLE       PROJECT NUM         d Research       0602601F Space Technology       1010 Space         surveillance       Surveillance       Surveillance         complishments/Planned Program (\$ in Millions)       EY 2006       EY 2007         vational studies of seismic wave propagation, including propagation in Eurasia. Continue to act detailed studies of particular challenge areas in local seismic monitoring. Refine design and act theoretical, laboratory, and field studies to support local monitoring.       EY 2006       EY 2007         GRESSIONAL ADD: High-frequency Active Auroral Research Program.       3.306       3.188         '2006: Conducted Congressionally-directed effort for HAARP.       2007: Conduct Congressionally-directed effort for National Security Research - Signature.       1.361       1.295         '2007: Conduct Congressionally-directed effort for Vational Security Research - Signature.       2008: Not Applicable.       2008: Not Applicable.         '2008: Not Applicable.       2009: Not Applicable.       47.152       48.567         Ker Program Funding Summary (\$ in Millions)       EY 2006       EY 2007       EY 2008       Ey 2010       EY 2012       EY 2012         '2009: Not Applicable.       Cost       47.152       48.567         Ker Program Funding Summary (\$ in Millions)       Estimate       Estimate <th>Y 2007</th> <th colspan="2"><u>FY 2008</u> FY 2</th>	Y 2007	<u>FY 2008</u> FY 2							
	conduct detailed studies of particu	ılar challenge	areas in local	seismic monito	ring. Refine d						
(U) (U)	CONGRESSIONAL ADD: High	-frequency A	ctive Auroral F	Research Progr	am		3 3	306	3 188	0.000	0.000
(U)	-			-	ann.		5	500	5.100	0.000	0.000
(U)		•									
(U)	In FY 2008: Not Applicable.		••••••								
(U)	In FY 2009: Not Applicable.										
(U)											
(U)	CONGRESSIONAL ADD: USA	F Center for M	National Securi	ity Research - S	Signature.		1.3	361	1.295	0.000	0.000
(U)	In FY 2006: Conducted Congress Exploitation.	sionally-direct	ed effort for N	lational Securit	y Research - S	ignature					
(U)	In FY 2007: Conduct Congressio	nally-directed	effort for USA	AF National Se	curity Researc	h - Signature.					
(U)	In FY 2008: Not Applicable.										
(U)	In FY 2009: Not Applicable.										
(U)	Total Cost						47.	152	48.567	43.484	46.991
(U)	C. Other Program Funding Sum	<u>mary (\$ in N</u>	<u>fillions)</u>								
		FY 2006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	FY 2011	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	Total Cost
		<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	$\frac{10tar Cost}{2}$
(U)	Related Activities:										
(U)	PE 0305111F, Weather										
	Systems.										
(U)	PE 0305160F, Defense										
	Meteorological Satellite										
	Program.										
(U)											
(LD)											
(0)	Sensors.										
ЛD											
(0)				ſ	R-1 Line Item No	11					
	ject 1010			ſ	Page-9 of 24						PE 0602601F)

Exhibit R-2a, RDT&E Pr	roject Justification	DATE	February 2007
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology		BER AND TITLE Survivability &
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>			
Spacecraft Technology.			
U) This project has been			
coordinated through the Reliance 21 process to			
harmonize efforts and			
eliminate duplication.			
U) D. Acquisition Strategy			
Not Applicable.			
Project 1010	R-1 Line Item No. 11 Page-10 of 24		Exhibit R-2a (PE 0602601
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		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY oplied Research					IBER AND TITL 01F Space T		48	OJECT NUMBE 46 Spacecra chnologies		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
49.46		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4846	Spacecraft Payload Technologies Quantity of RDT&E Articles	<u>16.314</u> 0	17.150 0	22.949	21.877	24.050	24.224	25.181	25.755	Continuing	TBD
Note:	Funds for the FY 2007, Congressiona	-	Ŷ	ő	Ŷ	_	Ş	÷	ş	L to PE 0602702	<u> </u> ?F
	nand, Control and Communications, P		-			amount of $\varphi_2$	.2 minon we		n uns i roject	IO I L 0002702	,
t t t	<b>A. Mission Description and Budget</b> This project develops advanced technor four primary areas: (1) development of data generation and exploitation technor echnologies; (3) development of high	ologies that en f advanced, sp ologies, incluc -fidelity space	hance spacecr ace-qualified, ling infrared, l simulation m	survivable ele Fourier Trans odels that sup	ectronics, and form hyperspe port space-bas	electronics pa ectral imaging, sed surveillanc	ckaging techn polarimetric e and space a	ologies; (2) desensing, and s sset protection	evelopment of atellite antenn n research and	f advanced spa a subsystem development	ice
	the warfighter; and (4) development of communication systems.	f advanced net	working, radi	o frequency, a	and laser com	nunications tee	chnologies to	support next g	generation sate	ellite	
(U) (U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop advance hardened space detector arrays with ir discrimination of space objects such a In FY 2006: Performed studies in me Improved quantum dot detector respo- magnetic and electric field tuning of d Performed comparisons of emerging of Characterized and assessed performar radiation hardened-by-design process.	ed infrared devenproved detects decoys, sate tal films. Der nsivity. Chara letector waveled tetector technologies of long wa	ice technologi tion, to perfor llites, and war nonstrated two acterized super ength responsi blogies for tran velength infra	m acquisition heads through p-layer single- lattice detector vity ("wavele nsfer to applie red focal plan	, tracking, and nout their trajec- pixel polarime ors. Investigat ength agility"). ed research. ne arrays develo	ctory. eter. red oped with	<u>FY 20</u> 3.6		<u>¥ 2007</u> 3.200	<u>FY 2008</u> 4.166	<u>FY 2009</u> 4.976
	In FY 2007: Pursue detector response amplification of incoming weak signa focal plane arrays (FPAs). Pursue lon passivation optimization.	ls. Study radi	ation damage	of very long v	wavelength and	d visible					
(U)	In FY 2008: Continue investigating s technologies. Demonstrate a three-lay reduction and passivation optimization In FY 2009: Continue investigating s	yer single pixe n.	l polarimeter.	Continue LW	VIR superlattic						
· · ·	micron increments. Continue investigating s			U							
Proje	ect 4846				Line Item No. 1 Page-11 of 24 273	1				Exhibit R-2a (P	E 0602601F)

	Exhibit R-2a, RDT&E Project Just	tification		DATE	February	2007
	SET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Teo	chnology		IBER AND TITLE craft Payload es	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> using quantum interference and demonstrate enhancement using plasmons. Continu- single pixel polarimeter. Demonstrate improved LWIR superlattice detector and ass infrared feasibility.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop spectral sensing and data exploitation methodologies for and remote sensing applications.	or military imaging	0.987	0.868	1.137	1.225
(U)	In FY 2006: Completed development and continued validation of polarimetric scene capability for space-based surveillance applications. Integrated additional models for prediction of satellite materials signatures and compared with available laboratory and Completed development of instrument models for staring polarimetric surveillance s polarimetric and spectral measurement and database of relevant materials for inclusion	r accurate nd field data. ystems. Developed				
(U)	In FY 2007: Complete validation of polarimetric scene and signature modeling capa simulated data to measured field data. Complete initial polarimetric database of mat signature and scene modeling. Define concepts for polarimetric or multi-band imagi space-based space surveillance applications.	erials for use in				
(U)	In FY 2008: Begin development of a predictive model for advanced imaging concept physics-based models, develop an end-to-end capability to predict the performance, various sensors for Intelligence, Surveillance, and Reconnaissance (ISR) and SSA approximately approxima	benefit, and cost of				
(U)	In FY 2009: Complete the development and begin the validation of a predictive modification imaging. Validate against laboratory and available field data of ISR and SSA mission improvements to the simulation capability to improve accuracy and usability of the rediction capability to develop concepts for purpose built sensors for SSA.	ons. Make				
(U) (U)	MAJOR THRUST: Develop technologies for space-based payload components such performance, radiation-hardened electronic devices, micro-electro-mechanical system	n devices, and	4.129	2.985	3.706	3.834
(U)	advanced electronics packaging for next generation high performance space electron In FY 2006: Designed new chalcogenide materials for reconfigurable radio frequence for reconfigurable wiring. Developed fundamental understanding of exotic high-die materials and predicted candidate materials for insertion into aggressively scaled electronics. Researched radiation effects in highly integrated microelectronics recent techniques in power management, clock domain partitioning, and monolithic	cy (RF) circuits and lectric constant ctronic devices for employing the most				

Exhibit R-2a, RDT	<b>&amp;E Project Justification</b>		DATE	February	2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Tee	chnology		IBER AND TITLE	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> multiple radio frequency, analog, and digital functions. Identified techniques for enhancing immunity to single event and other radio space environment, as well as nuclear events. Developed a "liquid combining micro-electromechanical switches and reconfigurable."	liation effects arising from the natural uid manifold" approach based on e wiring and demonstrate operation.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2007: Complete study of dynamics of phase change mate pertinent technological materials. Explore use of polymers in red of alternative dielectrics for advanced electronics, especially the nanotechnology collaboration with the Air Force Research Labor radiation effects mitigation schemes using best commercial prac- identify new methods for creating radiation hardened, long-lifeti- signal microcircuits for next generation space and missile system hardening techniques to determine robustness and compatibility fabrication technology. Develop morphable electronic panels su environment.	configurable electronics. Continue study e nitrided oxides. Initiate a oratory Materials Directorate. Research etices in design and manufacturing to ime, commodity and custom mixed ns. Evaluate devices using advanced with state of the art design and				
(U) In FY 2008: Initiate capabilities to the current Satellite Design A sequence to form a "push-button toolflow" satellite builder. Init interface modules allocating standardized data messages protoco of sensors and actuators.	iate Radiation-harden space sensor				
(U) In FY 2009: Complete capabilities to the current Satellite Desig logical sequence to form a "push-button toolflow" satellite build sensor interface modules allocating standardized data messages control of sensors and actuators.	ler. Demonstrate radiation-harden space				
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop modeling, simulation, and analysis systems, rendezvous and proximity operations, optical/infrared i satellite architecture, and space control payloads. Note: In FY 2 acceleration of the development of engineering and military utiliof space situational awareness and defensive counterspace technic</li> </ul>	imaging space systems, distributed 2008, increase in funding is due to ity models for space superiority analysis	2.441	2.501	6.428	3.508
<ul> <li>(U) In FY 2006: Supported autonomous and responsive space flight validation. Extended the simulation architecture to feed engineer models. Extended the architecture to address missions associate</li> </ul>	t experiments with simulations and data ering-level data to mission/campaign				
	R-1 Line Item No. 11				

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Tee	chnology		ABER AND TITLE craft Payload es	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> tactical surveillance. Developed enhancements to imaging system simulations to incl and hyperspectral effects. Tailored toolset and methodology developed for the multi- system feasibility study for tactical applications.	*	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Continue to support autonomous and responsive space flight experimen and data validation. Continue to extend the simulation architecture to feed engineerin mission/campaign models. Ready the simulation architecture to support flight experi and data validation for experiments on space situational awareness and tactical survei	ng-level data to ment simulation				
(U)	In FY 2008: Complete support of autonomous and responsive space flight experimer and data validation. Complete extension of the simulation architecture to feed engine mission/campaign models. Begin to develop engineering and military utility models superiority analysis of space situational awareness and defensive counterspace technol	nts with simulations eering-level data to for space				
(U)	In FY 2009: Continue to develop engineering and military utility models for space su of space situational awareness and defensive counterspace technologies.	periority analysis				
(U)		······································	5 101	5 504	7.510	0.224
(U)	MAJOR THRUST: Develop technologies for multi-access laser communications term maturity of single access terminal components and their applicability to a multi-access		5.121	5.504	7.512	8.334
(U)	In FY 2006: Verified initial standards of combining multiple airborne intelligence, su reconnaissance and space asset feeds into a single optical data path. Performed comp laboratory testbed.	arveillance and				
(U)	In FY 2007: Finish verification of standards of multiple airborne intelligence, surveil reconnaissance and space asset feeds into a single optical data path. Perform system laboratory testbed.					
(U)	In FY 2008: Begin integration of single-access laser communications terminal comp	onents into				
(U)	multi-access laser communications terminal. In FY 2009: Complete integration of single-access laser communications terminal comulti-access laser communications terminal.	omponents into				
(U)			0.000	0.007	0.000	0.000
	CONGRESSIONAL ADD: Field Programmable Gate Arrays. In FY 2006: Not Applicable.		0.000	0.996	0.000	0.000
	In FY 2007: Conduct Congressionally-directed effort for Field Programmable Gate A	Arrays.				
	In FY 2008: Not Applicable.					
Proj	ect 4846 R-1 Line It Page-1				Exhibit R-2a (I	PE 0602601F)

	Fxhihi	: R-2a, RD		t Justific				DATE			
BUDGET ACTIVITY 02 Applied Research		. N-20, ND		PEI	PE NUMBER AND TITLE PRO 0602601F Space Technology 484				February 2007         PROJECT NUMBER AND TITLE         4846 Spacecraft Payload         Technologies		
<ul> <li>(U) <u>B. Accomplishments/Planned</u></li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	Program (\$ in	<u>Millions)</u>				<u>FY 2</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Na</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Conduct Congress Technology Development.</li> </ul>				-		0.0	000	1.096	0.000	0.000	
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> </ul>						16.	314	17.150	22.949	21.877	
(U) <u>C. Other Program Funding Su</u>	ummary (\$ in N <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> FY 2007 Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimat			TOTAL COST	
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0603401F, Advanced Spacecraft Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>											
(U) <u>D. Acquisition Strategy</u> Not Applicable.											
Project 4846				R-1 Line Item N Page-15 of 2					Exhibit R-2a (I	PE 0602601F)	
			ι	277 Jnclassif	FIED						

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY pplied Research					IBER AND TITL 01F Space T		50	OJECT NUMBE 18 Spacecra chnology	ER AND TITLE aft Protectio	n
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
5010		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5018	Spacecraft Protection Technology Quantity of RDT&E Articles	2.129	1.923	2.548	3.503	3.831	3.840	4.657	4.754	Continuing	TBD
(U)	A. Mission Description and Budget			0	0	0	0	0	0		
	This project develops the technologies performance loss in support of warfigl technologies, and developing technologies	s for protecting hter requireme	g U.S. space as nts. The proje	ect focuses on	identifying ar	nd assessing sp	bacecraft syste		-		ing
	<b>B.</b> Accomplishments/Planned Progr						<u>FY 20</u>		<u> 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop key sate asset defense.	ellite threat wa	rning technolo	gies and tools	s for high valu	e satellite	0.8	08	0.846	1.026	1.115
(U) (U) (U)	In FY 2006: Processed integrating mexperiment. Identified potential of mphenomenon associated with space flietc.). In FY 2007: Conduct sensor testing a In FY 2008: Continue to conduct sentransition opportunities and provide a In FY 2009: Transfer an active and/o co-orbital vehicle and transition these	ultiple usage of ight (weather e and analysis. I sor space fligh ssociated engi- r passive threa	f sensor to det experiments, d dentify techno at experiment a neering design t warning sense	ect threats an ebris analysis ology transitio and analysis. as and concept	d measure env , assist in navi on opportunitie Identify techn ts.	ironmental gation, s. ology					
(U)	MAJOR THRUST: Develop high val In FY 2006: Downselected to the mo and integration. Identified potential of environmental phenomenon associate	st promising d of multiple use	efensive techr technology to	ology for spa detect threats	s and measure		0.5	29	0.548	0.870	1.678
(U)	navigation, etc.). In FY 2007: Conduct defensive techr transfer opportunities.	nology space d	emonstration	and analysis.	Identify techn	ology					
	In FY 2008: Develop space experime experiment to validate concept and m	e	•	develop proc	of of concept s	pace					
	In FY 2009: Identify two technology geosynchronous orbit/low earth orbit				-	ion into					
Proj	ect 5018				Line Item No. 1 Page-16 of 24	1				Exhibit R-2a (P	E 0602601F)
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		Exhibit	R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007
-	GET ACTIVITY Applied Research					UMBER AND TI 2601F Space	TLE • Technology	ť	PROJECT NUMB 5018 Spaceci Fechnology		on
(U)	B. Accomplishments/Planned	<u>Program (\$ in</u>	<u>Millions)</u>				<u>FY 20</u>	006	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop tec satellite-as-a-sensor, and self-aw In FY 2006: Developed space e	vare satellite tec	chnologies as a	first-line threa	t detection sys	tem.	0.5	522	0.529	0.652	0.710
(0)	concept space experiment to val	-	cooperation and a cooperation of the cooperation of	uive onboard s	ystem of dever	oped proof of					
(U)	In FY 2007: Conduct defensive transfer opportunities.	-	ace demonstrat	ion and analysi	s. Identify tec	hnology					
(U)	In FY 2008: Transition technolo	ogy to other con	mpatible space	systems for m	ultiple uses.						
(U)	In FY 2009: Identify technology	y transition opp	ortunities and	provide engine	ering designs t	o potential					
(U)	users.										
(U)	MAJOR THRUST: Develop tec compatibility between ultra-sens forecasting. Note: Effort comp	itive payload s	ensors for space	-	-		0.2	270	0.000	0.000	0.000
(U)	In FY 2006: Conducted space e measuring ionospheric and scint mission planners and other users	xperiment dem illation parame	onstration of C								
(U)	In FY 2007: Not Applicable.										
(U)	In FY 2008: Not Applicable.										
(U)	In FY 2009: Not Applicable.										
(U)	Total Cost						2.1	29	1.923	2.548	3.503
(U)	C. Other Program Funding Su	<u>mmary (\$ in N</u>	<u>(Iillions)</u>								
		<u>FY 2006</u>	<u>FY 2007</u>	FY 2008	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	Total Cost
		<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	Estimate	Complete	
(U)	PE 0603401F, Advanced										
(II)	Spacecraft Technology. This project has been										
(0)	coordinated through the										
	Reliance 21 process to										
	harmonize efforts and										
	eliminate duplication.										
Pro	ject 5018			F	R-1 Line Item No Page-17 of 24					Exhibit R-2a (I	PE 0602601F)
. 10	100.0010				279	•					_ 00020011 )

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY <b>2 Applied Research</b>	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 5018 Spacecraft Protection Technology
U) D. Acquisition Strategy		
Not Applicable.		
Project 5018	R-1 Line Item No. 11 Page-18 of 24	Exhibit R-2a (PE 0602601
	280	

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
	BET ACTIVITY pplied Research					IBER AND TITL 01F Space T			DECT NUMBER AND TITLE 9 Spacecraft Vehicle hnologies		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
8809		38.009	35.832	40.585	34.384	49.509	48.895	46.817	48.148	Continuing	TBD
Nota	Quantity of RDT&E Articles Funds for the FY 2007 Congressiona	0	0	0	0	0	0	0	0	DE 06025001	7
06022 (U)	-Disciplinary Space Technology, Proj. 203F, Aerospace Propulsion, Project 6 <b>A. Mission Description and Budget</b> This project focuses on seven major sp (e.g., survivable electronics); satellite simulation of space-based systems; sa microsatellite technologies; and space	233SP, to this Item Justifica pace technolog control (e.g., s tellite protectio	Project, for ex tion y areas: space oftware for au on technologie	ecraft platform tonomous dis (e.g., space	ns (e.g., structu stributed satell environment e	ires, controls, ite formation f effects, debris	power, and th Tying, signal I	ermal manage processing, an	ement); space- d control); mo	based payload odeling and	S
(U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop technolo	ram (\$ in Mill	ions)	-			<u>FY 20</u> 3.5		<u>7 2007</u> 3.175	<u>FY 2008</u> 4.434	<u>FY 2009</u> 4.536
• •	compact, high efficiency solar power	U	1 1	•		•	5.5	80	5.175	4.434	4.330
	In FY 2006: Built experimental capal	•		1 0		•					
	Refined and validated cryocooler com thermodynamic loss mechanisms in re dynamics models. Demonstrated 12% five- or six- junction solar cell.	ponent and sy	stem models v cle cryocooler	with experime rs through con	ental data. Invental data. Inventational flu	estigated id					
	In FY 2007: Develop component-bass optimization of cryocooler system des mass and high efficiency advanced en methodologies to cryocooler industry lattice mismatch or five- or six- juncti thin-film solar cell on a polymer subs	sign. Design a ngineering mod . Demonstrate ion solar cell te	n ultra low-te lel cryocooler greater than 3 echnology. De	mperature (10) Transition o 33% efficient evelop a great	) degrees Kelv optimal design solar cell using ter than 12% e	in), low g either					
	In FY 2008: Continue to refine and v experimental data. Complete theoreti investigate thermodynamic loss mech fluid dynamics models. Complete der work for improved short-wavelength application needs for missile launch d	cal model of n anisms in rege finition and be infrared/mediu	nultistage cool nerative cycle gin procureme m-wavelengtl	er energy flow cryocoolers t ent technology n infrared (SW	ws. Continue through compu- y development VIR/MWIR) c	utational design ryocooler					
Proje	ect 8809				Line Item No. 1 Page-19 of 24	1				Exhibit R-2a (P	E 0602601F)
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	Exhibit R-2a, RDT&E Project Jus	stification		DATI	DATE February 2007			
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602601F Space Teo	hnology		IBER AND TITLE craft Vehicle es			
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> concept solar cells traceable to efficiencies greater than 40%. In FY 2009: Further refine and validate cryocooler component and system models data. Continue to investigate thermodynamic loss mechanisms in regenerative cycl through computational fluid dynamics models. Complete design work for improve cryocooler application for missile launch detection and technical intelligence missio Complete engineering demonstration of advanced array for thin-film solar cells sca 100 kw.	e cryocoolers d SWIR/MWIR on systems.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	MAJOR THRUST: Develop technologies for advanced space platform structures s controls for vibration suppression, multi-functional structures, deployable large ape		6.364	5.702	10.634	15.570		
(U)	and lightweight composite satellite and launch vehicle structures. In FY 2006: Developed advanced mechanisms and guidance strategies for capture disabled (non-cooperative) spacecraft. Developed high-temperature, long-soak time	and servicing of						
(U)	structures. In FY 2007: Characterize thermal protection structural performance in reentry environment autonomy concepts to support defensive/protection actions by spacecraft.	ronment. Develop						
(U)	In FY 2008: Complete characterization of thermal protection actions by spacectalat concepts to support defensive/protection actions by spacecraft. Begin development structural hardware concepts for space situational awareness, such as structural hear occultation by nearby objects, and detection of RF emissions. Begin development of architectures for large precision deployable structures. Begin development of adva algorithms for better local situational awareness using existing and next-generation star-trackers for object detection, characterization, and tracking.	of multifunctional lth monitoring, light of system-level need estimation						
(U)	In FY 2009: Continue development of multifunctional structural hardware concept situational awareness, such as structural health monitoring, light occultation by nea detection of RF emissions. Continue development of system-level architectures for deployable structures. Continue development of advanced estimation algorithms for situational awareness using existing and next-generation hardware, such as star-trac detection, characterization, and tracking.	rby objects, and large precision or better local						
(U)		1	10.040	15 214	05 517	14 079		
(U)	MAJOR THRUST: Develop flight experiments to address key scientific and technology		10.949	15.314	25.517	14.278		
Pro		e Item No. 11 20 of 24			Exhibit R-2a (I	PE 0602601F)		

	Exhibit R-2a, RDT&E Project	Exhibit R-2a, RDT&E Project Justification									
	BET ACTIVITY pplied Research	PE NUMBER AND TITI 0602601F Space		PROJECT NUM 8809 Spaced Technologie		2007					
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> order to improve the capabilities of existing operational space systems and to transformational space capabilities. Note: Funding changes are due to launch higher Air Force priorities.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>					
(U)	In FY 2006: Completed fabrication of spacecraft structure. Built and tested of experimental payloads. Completed mission planning and on-orbit operations spacecraft system Preliminary Design Review to freeze all interfaces. Advan for Critical Design Review.	guide. Completed									
(U)	In FY 2007: Complete Critical Design Review for all payloads to freeze all d fabrication of all flight hardware. Complete fabrication of integrated spacecra and electronics. Initiate delivery of individual experiment payloads and begin test with the core spacecraft.	aft core including structure									
	In FY 2008: Complete delivery of all spacecraft payloads. Complete spacecr and test. Train mission operations team for on-orbit activities. Prepare science operations using simulated data to certify the dissemination and analysis proc	ce teams for on-orbit									
	In FY 2009: Prepare spacecraft for launch. Complete all spacecraft to launch and approval. Launch spacecraft and commence with Mission Operations.	n vehicle interface analysis									
(U)	CONGRESSIONAL ADD: Converted Silicon Carbide for High Performance In FY 2006: Conducted Congressionally-directed effort for Converted Silicon Performance Optic Structures.	-	4.277	0.000	0.000	0.000					
(U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.										
(U) (U) (U) (U)	CONGRESSIONAL ADD: Consortium for Autonomous Satellite Systems ( In FY 2006: Conducted Congressionally-directed effort for CASS. In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	CASS).	1.459	0.000	0.000	0.000					
(U)	CONGRESSIONAL ADD: Large Aperture Deployable Structure Systems for	or Space.	1.944	0.000	0.000	0.000					
	ect 8809	-1 Line Item No. 11 Page-21 of 24			Exhibit R-2a (P						

	Exhibit R-2a, RDT&E Project Jus	stification		DATE	DATE February 20		
	T ACTIVITY plied Research	PE NUMBER AND TITLE 0602601F Space Te			IBER AND TITLE		
(U) <u>B</u> .	. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	n FY 2006: Conducted Congressionally-directed effort for Large Aperture Deploy	vable Structure					
-	ystems for Space.						
	n FY 2007: Not Applicable.						
	n FY 2008: Not Applicable.						
	n FY 2009: Not Applicable.						
(U)							
· /	ONGRESSIONAL ADD: Nano-Reinforced Structures and Advanced Multi-Fund	ctional Structures for	2.333	0.000	0.000	0.000	
-	pace Programs.						
• •	n FY 2006: Conducted Congressionally-directed effort for Nano-Reinforced Struct	ctures and Advanced					
	Iulti-Functional Structures for Space Programs.						
	n FY 2007: Not Applicable.						
	n FY 2008: Not Applicable.						
	n FY 2009: Not Applicable.						
(U)	ONCRESSIONAL ADD. Integrated Control for Autonomous Space Systems (IC	7400)	2 420	1 504	0.000	0.000	
	ONGRESSIONAL ADD: Integrated Control for Autonomous Space Systems (IC n FY 2006: Conducted Congressionally-directed effort for ICASS.	_A33).	2.430	1.594	0.000	0.000	
	1 FY 2007: Conduct Congressionally-directed effort for ICASS.						
	n FY 2008: Not Applicable.						
	n FY 2009: Not Applicable.						
(U) III	11 1 2009. Not Applicable.						
	ONGRESSIONAL ADD: Elastic Memory Composites (EMC).		1.459	0.996	0.000	0.000	
	n FY 2006: Conducted Congressionally-directed effort for Elastic Memory Comp	osites	1.109	0.990	0.000	0.000	
	n FY 2007: Conduct Congressionally-directed effort for Elastic Memory Compos						
	n FY 2008: Not Applicable.						
	n FY 2009: Not Applicable.						
(U)							
	ONGRESSIONAL ADD: Deployable Structures Experiment.		2.236	1.096	0.000	0.000	
	1 FY 2006: Conducted Congressionally-directed effort for Deployable Structures	Experiment.					
. ,	1 FY 2007: Conduct Congressionally-directed effort for Deployable Structures Ex	L .					
	1 FY 2008: Not Applicable.	-					
(U) In	n FY 2009: Not Applicable.						
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Project		e-22 of 24 284	1		Exhibit R-2a (I	-E 0602601F)	

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TI 0602601F Space			BER AND TITLE		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	CONGRESSIONAL ADD: Lightweight Photovoltaic Electricity and Hydrogen for F On-Demand Power/Center for Solar Electricity and Hydrogen.		0.972	3.587	0.000	0.000	
(U)	In FY 2006: Conducted Congressionally-directed effort for lightweight photovoltaic hydrogen for portable, on-demand power.	electricity and					
(U)	In FY 2007: Conduct Congressionally-directed effort for Center for Solar Electricity	and Hydrogen.					
(U)	In FY 2008: Not Applicable.						
(U) (U)	In FY 2009: Not Applicable.						
(U)	CONGRESSIONAL ADD: Flexible CIGS Solar Cells on Silicone Substrates for Spa	acecraft.	0.000	0.996	0.000	0.000	
(U)	In FY 2006: Not Applicable.						
(U)	In FY 2007: Conduct Congressionally-directed effort for Flexible CIGS Solar Cells of	on Silicone					
an	Substrates for Spacecraft. In FY 2008: Not Applicable.						
	In FY 2009: Not Applicable.						
(U)	11						
(U)	CONGRESSIONAL ADD: Joint Micro Power Initiative.		0.000	0.996	0.000	0.000	
(U)	In FY 2006: Not Applicable.						
(U)	In FY 2007: Conduct Congressionally-directed effort for Joint Micro Power Initiativ	е.					
(U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U)	In 1 2007. Not Applicable.						
(U)	CONGRESSIONAL ADD: Multicontinuum Technology for Space Structures.		0.000	0.996	0.000	0.000	
(U)	In FY 2006: Not Applicable.						
(U)	In FY 2007: Conduct Congressionally-directed effort for Multicontinuum Technolog	y for Space					
	Structures.						
	In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U)	In T 2009. Not Applicable.						
(U)	CONGRESSIONAL ADD: Shield Rocket Payloads.		0.000	0.284	0.000	0.000	
(U)	In FY 2006: Not Applicable.						
Dra	R-1 Line It						
Pro	ject 8809 Page-2	3 of 24 35			Exhibit R-2a (F	1E 0602601F)	

Exhibit R-2a, RDT&E Project Justi	fication	DATE February 2007		
BUDGET ACTIVITY 02 Applied Research	0602601F Space Technology 8809	ROJECT NUMBER AND TITLE 809 Spacecraft Vehicle echnologies		
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Shield Rocket Payloads.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	<u>FY 2006</u> <u>FY 2</u>	2007 <u>FY 2008 FY 2009</u>		
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Three Dimensional Deployable Structure Systems for Sp</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Three Dimensional Deploya Systems for Space.</li> </ul>		.096 0.000 0.000		
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	38.009 35	.832 40.585 34.384		
<ul> <li><u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 20</u> <u>Actual Estimate Estimate Estimate Estim</u></li> <li>(U) Related Activities:</li> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0602102F, Materials.</li> <li>(U) PE 060311F, Ballistic Missile Technology.</li> <li>(U) PE 0603401F, Advanced Spacecraft Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <b>D. Acquisition Strategy</b> Not Applicable.</li> </ul>		FY 2013 Cost to Estimate Complete		
Project 8809 R-1 Line Ite Project 8809 Page-2- 28	of 24	Exhibit R-2a (PE 0602601F)		

#### PE NUMBER: 0602602F PE TITLE: Conventional Munitions

BUDGET ACTIVITY 02 Applied ResearchPE NUMBER AND TITLE 0602602F Conventional MunitionsCost (\$ in Millions)FY 2006FY 2007FY 2008FY 2009FY 2010FY 2011FY 2012FY 2013Cost to Cost to CompleterTotal Program Element (PE) Cost58.01261.86857.80456.08159.52159.54060.18262.187Continue2068Advanced Guidance Technology18.55417.88917.89118.01519.18019.23819.64420.091Continue	DATE February 2007			ion	Justificat	udget Item	RDT&E Bu	hibit R-2,	Ex	
Cost (§ in Millions)ActualEstimateEstimateEstimateEstimateEstimateEstimateEstimateCompleTotal Program Element (PE) Cost58.01261.86857.80459.52159.54060.18262.187Continu2068Advanced Guidance Technology18.55417.89118.01519.18019.23819.64420.091Continu2010Ordnance Technology39.45843.97939.91338.06640.34140.30240.53842.096ContinuNote:In FY 2006, funding increased to support added emphasis on Battlefield Air Operations efforts.Image: Continu State Continu State Continu State Continu State Continu State Continu State Continu State Continue State Conti		ons								
ActualEstimateEstimateEstimateEstimateEstimateEstimateEstimateCompteTotal Program Element (PE) Cost58.01261.86857.80456.08159.52159.52460.18262.187Continu2068Advanced Guidance Technology18.55417.89118.01519.18019.23819.64420.091Continu2502Ordnance Technology39.45843.97939.91338.06640.34140.30240.53842.096Continu2006In FY 2006funding increased to support added emphasis on Battlefield Air Operations efforts.UA.Mission Description and Budget Item JustificationThis program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance technologies, including seekers, navigation and control, ta detection and identification algorithms, and simulation assessments; and (2) development of conventional ordnance technologies, including warheads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments. This program is in Budget Activity 2, Applied Research, since it develo determines the technical feasibility and military utility of evolutionary and revolutionary technologies.U)Previous President's Budget62.06162.10558.771U)Current PBR/President's Budget9.0038-0.235U)Total Adjustments-4.049-4.049U)Congressional Rescissions0.038-0.235Congressional Rescissions-3.321-1.300Reprogrammings-3.321-1.300SBIR/	TY 2013 Cost to Total	FY 2012 FY	FY 2011	FY 2010	FY 2009	FY 2008	FY 2007	FY 2006		
2068       Advanced Guidance Technology       18.554       17.89       17.891       18.015       19.180       19.238       19.644       20.091       Continue         2502       Ordnance Technology       39.458       43.979       39.913       38.066       40.341       40.302       40.538       42.096       Continue         Note:       In FY 2006, funding increased to support added emphasis on Battlefield Air Operations efforts.       U)       A. Mission Description and Budget Item Justification       This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance technologies, including seekers, navigation and control, ta detection and identification algorithms, and simulation assessments; and (2) development of conventional ordnance technologies, including warheads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments. This program is in Budget Activity 2, Applied Research, since it develo determines the technical feasibility and military utility of evolutionary technologies.         U)       Previous President's Budget       62.061       62.105       58.771         U)       Congressional Program Reductions       -0.002       -0.002         U)       Total Adjustments       -4.049       -0.002         U)       Congressional Rescissions       0.038       -0.235         Congressional Rescissions       -3.321       -1.300         Reprogrammi			Estimate	Estimate	Estimate	Estimate	Estimate	Actual	Cost (\$ in Millions)	
2502       Ordnance Technology       39.458       43.979       39.913       38.066       40.341       40.302       40.538       42.096       Continu         Note:       In FY 2006, funding increased to support added emphasis on Battlefield Air Operations efforts.       U)       A.Mission Description and Budget Item Justification       This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies including seekers, navigation and control, ta detection and identification algorithms, and simulation assessments; and (2) development of conventional ordnance technologies, including warheads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments. This program is in Budget Activity 2, Applied Research, since it develot determines the technical feasibility and military utility of evolutionary and revolutionary technologies.         U)       Pregram Change Summary (\$ in Millions)         U)       Previous President's Budget       58.012       61.868       57.804         U)       Congressional Program Reductions       -0.002       -0.002       -0.002       -0.002       -0.002       -0.002       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.0766       -0.076	62.187 Continuing TB	60.182	59.540	59.521	56.081	57.804	61.868	58.012	Total Program Element (PE) Cost	
Note:       In FY 2006, funding increased to support added emphasis on Battlefield Air Operations efforts.         U)       A. Mission Description and Budget Item Justification         This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies for convention air-launched munitions. The program includes two projects: (1) development of advanced guidance technologies, including warkeads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments. This program is in Budget Activity 2, Applied Research, since it develop determines the technical feasibility and military utility of evolutionary and revolutionary technologies.         U)       B. Program Change Summary (\$ in Millions)         EY 2006       EY 2007         Previous President's Budget       62.061         0.2015       58.771         U)       Current PBR/President's Budget       -4.049         U)       Congressional Program Reductions       -0.002         Congressional Increases       1.300         Reprogrammings       -3.321       -1.300         SBIR/STTR Transfer       -0.766         U)       Significant Program Changes:       Not Applicable.	20.091 Continuing TB	19.644	19.238	19.180	18.015	17.891	17.889	18.554	Advanced Guidance Technology	2068
U       A. Mission Description and Budget Item Justification         This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies for convention air-launched munitions. The program includes two projects: (1) development of advanced guidance technologies, including seekers, navigation and control, ta detection and identification algorithms, and simulation assessments; and (2) development of conventional ordnance technologies, including warheads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments. This program is in Budget Activity 2, Applied Research, since it develop determines the technical feasibility and military utility of evolutionary and revolutionary technologies.         U       B. Program Change Summary (\$ in Millions)         U       Previous President's Budget       62.061       62.105       58.771         U       Current PBR/President's Budget       58.012       61.868       57.804         U       Total Adjustments       -0.002       -0.002         U       Congressional Increases       1.300         Reprogrammings       -3.321       -1.300         SBIR/STTR Transfer       -0.766       -0.766         U       Significant Program Changes; Not Applicable.       C. Performance Metrics	42.096 Continuing TB	40.538	40.302	40.341	38.066	39.913	43.979	39.458	2 Ordnance Technology	2502
This program investigates, develops, and establishes the technical feasibility and military utility of advanced guidance and ordnance technologies for convention air-launched munitions. The program includes two projects: (1) development of advanced guidance technologies, including seekers, navigation and control, ta detection and identification algorithms, and simulation assessments; and (2) development of conventional ordnance technologies, including warheads, fuzes, explosives, munitions integration, and weapon lethality and vulnerability assessments. This program is in Budget Activity 2, Applied Research, since it develot determines the technical feasibility and military utility of evolutionary and revolutionary technologies.         U)       B. Program Change Summary (\$ in Millions)         V:       FY 2006       FY 2007       FY 2008         U)       Previous President's Budget       62.061       62.105       58.771         U)       Current PBR/President's Budget       58.012       61.868       57.804         U)       Total Adjustments       -0.002       0002       0002         U)       Congressional Rescissions       0.038       -0.235       0.038       0.235         U)       SBIR/STTR Transfer       -0.766       -0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766       0.766 <td< td=""><td></td><td></td><td></td><td>ts.</td><td>perations effor</td><td>lefield Air Op</td><td>phasis on Bat</td><td>port added en</td><td>: In FY 2006, funding increased to supp</td><td>Vote:</td></td<>				ts.	perations effor	lefield Air Op	phasis on Bat	port added en	: In FY 2006, funding increased to supp	Vote:
FY 2006FY 2007FY 2008U) Previous President's Budget62.06162.10558.771U) Current PBR/President's Budget58.01261.86857.804U) Total Adjustments-4.049-0.002U) Congressional Program Reductions-0.002-0.002Congressional Rescissions0.038-0.235Congressional Increases1.300-1.300Reprogrammings-3.321-1.300SBIR/STTR Transfer-0.766-0.766U) Significant Program Changes: Not Applicable.C. Performance Metrics-0.766	ation and control, target warheads, fuzes,	ng seekers, naviga ologies, including	logies, includir dnance techno	dance technol nventional or ogram is in B	f advanced gui elopment of co nents. This pr	evelopment of s; and (2) deve ability assess	projects: (1) d on assessment lity and vulner	includes two j , and simulati weapon lethal	air-launched munitions. The program i detection and identification algorithms, explosives, munitions integration, and	6 (
U)Previous President's Budget62.06162.10558.771U)Current PBR/President's Budget58.01261.86857.804U)Total Adjustments-4.049-0.002U)Congressional Program Reductions-0.038-0.235Congressional Increases1.3001.300Reprogrammings-3.321-1.300SBIR/STTR Transfer-0.766-0.766U)Significant Program Changes: Not Applicable0.766								<u>Millions)</u>	B. Program Change Summary (\$ in I	U) <u>I</u>
U)Current PBR/President's Budget58.01261.86857.804U)Total Adjustments-4.049-0.002U)Congressional Program Reductions-0.002Congressional Rescissions0.038-0.235Congressional Increases1.300Reprogrammings-3.321SBIR/STTR Transfer-0.766U)Significant Program Changes: Not Applicable0.766										
U)Total Adjustments-4.049U)Congressional Program Reductions-0.002Congressional Rescissions0.038-0.235Congressional Increases1.300Reprogrammings-3.321-1.300SBIR/STTR Transfer-0.766U)Significant Program Changes: Not Applicable0.766									•	
U)Congressional Program Reductions-0.002Congressional Rescissions0.038-0.235Congressional Increases1.300Reprogrammings-3.321-1.300SBIR/STTR Transfer-0.766U)Significant Program Changes: Not Applicable0.766C. Performance Metrics-0.766	57.804 56.081	61.868							•	
Congressional Rescissions0.038-0.235Congressional Increases1.300Reprogrammings-3.321-1.300SBIR/STTR Transfer-0.766U)Significant Program Changes: Not ApplicableC. Performance Metrics-		0.002	49	-4.04						
Congressional Increases       1.300         Reprogrammings       -3.321       -1.300         SBIR/STTR Transfer       -0.766         U)       Significant Program Changes: Not Applicable.       -0.766         C. Performance Metrics       -0.766			20	0.0					•	
Reprogrammings       -3.321       -1.300         SBIR/STTR Transfer       -0.766         U)       Significant Program Changes: Not Applicable.       -0.766         C. Performance Metrics       -0.766			38	0.0.					•	
SBIR/STTR Transfer       -0.766         U)       Significant Program Changes: Not Applicable.         C. Performance Metrics			21	-3.3					•	
<ul> <li><u>Significant Program Changes:</u> Not Applicable.</li> <li>C. Performance Metrics</li> </ul>		1.500								
Not Applicable. C. Performance Metrics			00	0.7						
(U) Under Development.									C. Performance Metrics	(
									(U) Under Development.	(
R-1 Line Item No. 12					_ine Item No. 12	R-1				
Page-1 of 10 Exhibit R- 287	Exhibit R-2 (PE 0602602F)									

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY pplied Research					IBER AND TITL D2F Conven		tions 2	PROJECT NUMBER AND TITLE 2068 Advanced Guidance Technology		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
2069		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate		Complete Continuing	
2068	Advanced Guidance Technology Quantity of RDT&E Articles	18.554 0	17.889 0	<u>17.891</u> 0	18.015 0	<u>19.180</u> 0	19.238 0	19.644		Continuing	TBD
(U)	A. Mission Description and Budget		-		· · · ·				· · · ·		
	This project investigates, develops, an project includes development of advan simulations. Project payoffs include: vehicle survivability; improved reliab	nced guidance adverse-weath	including tern her and autono	ninal seekers, mous precisio	navigation and on guidance ca	l control, sign pability; incre	al and process ased number	sing algorithr of kills per so	ns, and guidan	ce and control	
(U)										<u>FY 2009</u> 5.080	
	In FY 2006: Incorporated and tested goal to provide "single-shot" imaging aperture radar seeker. Fabricated and targeting against obscured targets. Us automatic target acquisition algorithm	at useful rang optical seeker t sing ground tes	es. Completed hat uses multi st data, augme	l testing of a l -discriminate nted the shape	low-cost synth signatures to i e signatures in	etic mprove					
	In FY 2007: Continue improving and "single-shot" imaging. Continue fabr to improve targeting obscured targets in the automatic target acquisition alg	ication of an o . Using ground gorithms to add	ptical seeker t d test data, cor laser multi-di	hat uses multi ntinue augmen scriminate sig	i-discriminate nting the shape gnatures.	signatures					
	provide "single shot" imaging at useful ranges. Lab test an optical seeker that uses multi-discriminate signatures to improve targeting of obscured targets. Develop Synthetic Aperture Radar (SAR) system simulation for designing Radar Frequency (RF) seeker technologies analysis.										
	In FY 2009: Laboratory demonstrations shot" images of useful targets. Test a signatures to improve targeting obscu	nd demonstrat	e an optical se	eker that uses	s multi-discrim	inate					
Proje	ect 2068				Line Item No. 12 Page-2 of 10	2				Exhibit R-2a (P	E 0602602F)
					288						

multi mode seeker that provides improved performance in two wavelength bands.         (U)         (U)         MAJOR THRUST: Investigate and develop advanced navigation and control technologies for air delivered munitions to include nonlinear controllers, biomimetic guidance, clutter rejectin modules, detection and segmentation modules, and micro-electromechanical gyros. These technologies will allow a more efficient flight path to target, increase stand off ranges, improve resistance to Global Positioning System (GPS) jamming, and enhance strike aircraft effectiveness and survivability.       3.420       3.800       3.300       3.455         (U)       In FY 2006: Developed navigation and guidance techniques to autonomously guide cooperative robotic weapons without location in form GPS parming environments.       Evaluated advanced navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue developing small agile vehicle guidance to avoid obstacles. Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in an urban-like environment. Continue evaluating navigation systems within GPS jamming environments.       U)       In FY 2008: Test navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue evaluating navigation systems within GPS jamming environments.       U)       In FY 2008: Test navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue applying neuro-physiology of insects to guide small vehicles for moving targets in urban like environments. Continue evaluating navigation system within GPS jamming environments. Continue evaluating		Exhibit R-2a, RDT&E Project Just	ification		DATE	DATE February 2007			
multi mode seeker that provides improved performance in two wavelength bands.         (U)         (U)         MAJOR THRUST: Investigate and develop advanced navigation and control technologies for air delivered munitions to include nonlinear controllers, biomimetic guidance, clutter rejectin modules, detection and segmentation modules, and micro-electromechanical gyros. These technologies will allow a more efficient flight path to target, increase stand off ranges, improve resistance to Global Positioning System (GPS) jamming, and enhance strike aircraft effectiveness and survivability.       3.420       3.800       3.300       3.455         (U)       In FY 2006: Developed anvigation and guidance techniques to autonomously guide cooperative robotic weapons without location inform GPS jamming environments.       1000000000000000000000000000000000000				onal Munitions	2068 Advan	vanced Guidance			
<ul> <li>(U) MAJOR THRUST: Investigate and develop advanced navigation and control technologies for 3.420 3.800 3.300 3.455 air-delivered munitions to include nonlinear controllers, biominetic guidance, clutter rejection modules, detection and segmentation modules, and micro-electromechanical gyros. These technologies will allow a more efficient flight path to target, increase stand off ranges, improve resistance to Global Positioning System (GPS). Developed navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from Global Positioning System (GPS). Developed guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue developing manil agile vehicles in close proximity to cluttered termain. Investigate due neuro-physiology of insects for application to guidance, chuteny enduating navigation systems within GPS jamming environments.</li> <li>(U) In FY 2006: To novine developing mavigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue eveloping small agile vehicles in an urban-like environment. Continue evaluating navigation systems within GPS jamming environments.</li> <li>(U) In FY 2008: To stavigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue evaluating navigation system within GPS jamming environments. Investigate using data links to provide target location updates for precision strike against mobile, time sensitive targets.</li> <li>(U) In FY 2009: Continue explaining environments. Investigate using data links to provide target location updates for precision strike against mobile, time sensitive targets. Investigate endogeis applicable to indoor navigation within GPS jamming environments.</li> <li>(U) MAIOR THRUST: Investigate and develop advanced optical and digital processors and target detection, classification, and identification algorith</li></ul>	(U)			<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
<ul> <li>(U) In FY 2006: Developed navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from Global Positioning System (GPS). Developed guidance techniques for small agile vehicles in close proximity to cluttered terrain. Investigated the neuro-physiology of insects for application to guidance, particularly engaging moving ground targets. Evaluated advanced navigation systems within GPS jamming environments.</li> <li>(U) In FY 2007: Continue developing navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue developing small agile vehicles to avoid obstacles. Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in an urban-like environment. Continue evaluating navigation systems within GPS jamming environments.</li> <li>(U) In FY 2008: Test navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue applying neuro-physiology of insects to guide small vehicles for moving targets in urban like environments. Continue novel evaluating navigation system within GPS jamming environments. Incontigate using data links to provide target location updates for precision strike against mobile, time sensitive targets.</li> <li>(U) In FY 2009: Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in urban like environments. Incontigate using data links to provide target location updates for precision strike against mobile, time sensitive targets.</li> <li>(U) In FY 2009: Continue applying the neuro-physiology of insects to guides mall vehicles to moving targets. Investigate using data location updates for precision strike against time sensitive targets. Investigate technologies applicable to indoor navigation within GPS jamming environments. Evaluate allows for engaging high agility, reduced signature targets. Investigate technologies applicable</li></ul>		air-delivered munitions to include nonlinear controllers, biomimetic guidance, clutter detection and segmentation modules, and micro-electromechanical gyros. These tech a more efficient flight path to target, increase stand off ranges, improve resistance to	rejection modules, mologies will allow	3.420	3.800	3.300	3.455		
<ul> <li>(U) In FY 2007: Continue developing navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue developing small agile vehicle guidance to avoid obstacles. Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in an urban-like environment. Continue evaluating navigation systems within GPS jamming environments.</li> <li>(U) In FY 2008: Test navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue applying neuro-physiology of insects to guide small vehicles for moving targets in urban like environments. Continue ovel evaluating navigation system within GPS jamming environments. Investigate using data links to provide target location updates for precision strike against mobile, time sensitive targets.</li> <li>(U) In FY 2009: Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in urban like environments. Continue evaluating navigation systems within GPS jamming environments. Continue evaluating navigation systems within GPS jamming environments. Continue evaluating navigation systems within GPS jamming environments. Location updates for precision strike against time sensitive targets. Investigate technologies applicable to indoor navigation within facilities.</li> <li>(U) MAJOR THRUST: Investigate and develop advanced optical and digital processors and target 2.803 2.809 3.570 3.851 detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. Continue developing highly innovative concepts and approaches in</li> </ul>	(U)	In FY 2006: Developed navigation and guidance techniques to autonomously guide weapons without location information from Global Positioning System (GPS). Deve techniques for small agile vehicles in close proximity to cluttered terrain. Investigate neuro-physiology of insects for application to guidance, particularly engaging movin	loped guidance						
<ul> <li>(U) In FY 2008: Test navigation and guidance techniques to autonomously guide cooperative robotic weapons without location information from GPS. Continue applying neuro-physiology of insects to guide small vehicles for moving targets in urban like environments. Continue novel evaluating navigation system within GPS jamming environments. Investigate using data links to provide target location updates for precision strike against mobile, time sensitive targets.</li> <li>(U) In FY 2009: Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in urban like environments. Continue evaluating navigation systems within GPS jamming environments. Continue evaluating navigation systems within GPS jamming environments. Evaluate utility data links to provide target location updates for precision strike against time sensitive targets. Investigate technologies applicable to indoor navigation within facilities.</li> <li>(U) MAJOR THRUST: Investigate and develop advanced optical and digital processors and target air-delivered weapon autonomy. Continue developing highly innovative concepts and approaches in</li> </ul>	(U)	In FY 2007: Continue developing navigation and guidance techniques to autonomous cooperative robotic weapons without location information from GPS. Continue developing guidance to avoid obstacles. Continue applying the neuro-physiology of inservehicles to moving targets in an urban-like environment. Continue evaluating navigation and guidance to avoid obstacles.							
<ul> <li>(U) In FY 2009: Continue applying the neuro-physiology of insects to guide small vehicles to moving targets in urban like environments. Continue evaluating navigation systems within GPS jamming environments. Evaluate utility data links to provide target location updates for precision strike against time sensitive targets. Investigate guidance navigation and control algorithms for engaging high agility, reduced signature targets. Investigate technologies applicable to indoor navigation within facilities.</li> <li>(U)</li> <li>(U) MAJOR THRUST: Investigate and develop advanced optical and digital processors and target 2.803 2.809 3.570 3.851 detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. Continue developing highly innovative concepts and approaches in</li> </ul>	(U)	In FY 2008: Test navigation and guidance techniques to autonomously guide cooper weapons without location information from GPS. Continue applying neuro-physiolo guide small vehicles for moving targets in urban like environments. Continue novel navigation system within GPS jamming environments. Investigate using data links to	gy of insects to evaluating						
(U) MAJOR THRUST: Investigate and develop advanced optical and digital processors and target       2.803       2.809       3.570       3.851         detection, classification, and identification algorithms for improved seeker performance to allow greater air-delivered weapon autonomy. Continue developing highly innovative concepts and approaches in       2.803       2.809       3.570       3.851	(U)	In FY 2009: Continue applying the neuro-physiology of insects to guide small vehic targets in urban like environments. Continue evaluating navigation systems within G environments. Evaluate utility data links to provide target location updates for precisitime sensitive targets. Investigate guidance navigation and control algorithms for engineering the sensitive targets.	PS jamming ion strike against gaging high agility,						
		MAJOR THRUST: Investigate and develop advanced optical and digital processors detection, classification, and identification algorithms for improved seeker performan	and target ace to allow greater	2.803	2.809	3.570	3.851		
R-1 Line Item No. 12           Project 2068         Page-3 of 10         Exhibit R-2a (PE 0602602F	Pro					Exhibit R-2a (	PE 0602602F)		

Exhibit R-2a, RDT&E Pr	DATI	February	2007		
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602602F Conventio	onal Munitions		UMBER AND TITLE I <b>nced Guidance</b> 3 <b>y</b>	
U) B. Accomplishments/Planned Program (\$ in Millions) guidance and control. These seekers will deny an enemy the ability to 1 while also decreasing aircrew workload.	hide or camouflage a target,	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>U) In FY 2006: Furthered biomimetic principles by developing modular n target attributes. Investigated polarization techniques to develop model in-house capability to evaluate contractor developed optic-flow algorith</li> </ul>	behavior theory. Developed				
U) In FY 2007: Continue investigating particular target attributes using bi developing polarization behavior theory models. Continue to evaluate c algorithms.	iomimetic principles. Continue				
U) In FY 2008: Verify biomimetic models through simulation. Continue theory models. Develop an optical flow enhanced seeker.	developing polarization behavior				
<ul> <li>U) In FY 2009: Continue verifying biomimetic models through simulation polarization theory models through simulation. Conduct tests on an op U)</li> </ul>					
<ul> <li>MAJOR THRUST: Investigate and develop detailed six-degree-of-free simulations including synthetic aperture radar, automatic target recogni Technologies also include trajectory optimization algorithm and polariz analyze guided munitions and their components that will enable require and evaluation, and experiment risk reduction. These simulations will development costs, and provide more effective munitions.</li> </ul>	ition, and biomimetic processing. zation sensing and models to ement studies, design iteration	4.200	4.568	5.400	5.629
U) In FY 2006: Completed development and establish a reusable, simulatises of reusable interoperable simulations to evaluate emerging munition developing an arbitrary waveform simulation using a commercial synthmulti-spectral phenomenology models for synthetic scene generation.	ns technologies. Completed				
<ul> <li>U) In FY 2007: Continue refining the set of interoperable simulations, val evaluate emerging munitions technologies. Improve existing multi-spe evaluate in a synthetic scene environment. Develop a set of reusable m simulations to be built from standardized components using standard components</li> </ul>	ectral phenomenology models and nodeling tools to allow munition				
U) In FY 2008: Continue refining the set of interoperable simulations, val evaluate emerging munitions technologies. Update and test multi-spect evaluate via synthetic scene simulation. Investigate laser radar (LADA demonstrate a feasible projection system for hardware-in-the-loop testing	lidating the reusable aspects, to tral phenomenology models and R) scene generation to				
Project 2068	R-1 Line Item No. 12 Page-4 of 10			Exhibit R-2a (I	PE 0602602F)

Exhibit R-2a, RDT&E Project Just		DATE
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE P 0602602F Conventional Munitions 2	February 2007         ROJECT NUMBER AND TITLE         068 Advanced Guidance         Jechnology
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) In FY 2009: Continue refining the set of interoperable simulations to evaluate emergy technologies. Integrate and test updates for multi-spectral phenomenology models a results via synthetic scene simulation. Continue the investigation of a LADAR scene capability for hardware-in-the-loop testing.</li> </ul>	ing munitions nd evaluate updated	FY 2007 FY 2008 FY 2009
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Falcon Eye.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Falcon Eye.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	2.043	0.000 0.000 0.000
<ul> <li>(U) Total Cost</li> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 20</u></li> </ul>		17.889 17.891 18.015 <u>FY 2013</u> <u>Cost to</u> Total Cost
Actual       Estimate       Estimate       Estimate         (U)       Related Activities:       (U)       PE 0603601F, Conventional         Weapons Technology.       (U)       This project has been       (U)         (U)       This project has been       (U)       (U)         Reliance 21 process to       (U)       (U)       (U)         (U)       (U)       (U) <td><u>nate Estimate Estimate Estimate</u></td> <td>Estimate Complete</td>	<u>nate Estimate Estimate Estimate</u>	Estimate Complete
(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.		
Project 2068 Page-	em No. 12 5 of 10 91 SSIFIED	Exhibit R-2a (PE 0602602F)

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	GET ACTIVITY										
02 /	pplied Research	<b>EV 2006</b>	TH 2007	<b>EX 2</b> 000			tional Munit		02 Ordnanc		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
250	2 Ordnance Technology	39.458	43.979	39.913	38.066	40.341	40.302	40.538	42.096	Continuing	g TBD
250	Quantity of RDT&E Articles	0	0	0	0	0	40.302	40.550	42.090	Continuing	
an	A. Mission Description and Budget	Item Instifics	ation								-
	This project investigates, develops, an advanced conventional weapon disper project also assesses the lethality and include: improved storage capability dispensing; low-cost airframe/subsyst	d evaluates consers, submuni effectiveness of and transporta	onventional or itions, safe and of current and tion safety of	l arm devices, planned conve fully assemble	fuzes, explosientional weapone; ir	ives, warheads ons technolog nproved warh	s, and weapon y programs an ead and fuze e	airframe and d assesses tar	carriage techr get vulnerabili	ology. The ty. The payo	
(U) (U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Investigate and d mechanics models for predicting weat tools will reduce air-delivered munition maximum lethality against a given tar	levelop high fi pons' effects a ons developme	delity analytic nd assessing ta	arget vulnerab	ility. These a	nalysis	<u>FY 20</u> 7.0		<u>¥ 2007</u> 6.700	<u>FY 2008</u> 7.810	<u>FY 2009</u> 8.800
(U)	In FY 2006: Developed code enhance new weapon concepts. Developed a s caused by direct weapon effects. Impr embedded soil, concrete or rock.	ements to com simplified finit	te element mo	del to estimate	e damage to bu	uildings					
(U)	In FY 2007: Continue modeling dam improving methods for predicting dar materials. Develop a model to predic facilities.	nage caused b	y detonation o	f penetrating	warheads in a	variety of					
(U)	In FY 2008: Continue modeling dam capability to apply first principles con concepts. Identify high payoff technol	nputational to	ols to the desig	gn and evaluat		-					
(U)	In FY 2009: Continue modeling dam developing capability to apply first pr munitions concepts. Continue to iden system level analysis tools to identify	inciples comp tify high payo	utational tools off technologie	to design and s for defeating	l evaluation of g mobile targe	new ts. Apply					
(U) (U)	MAJOR THRUST: Investigate and d blast explosives, cast and cure high er	-		-	-	-	5.8	03	6.600	6.000	6.700
Pro	ect 2502				Line Item No. 1 Page-6 of 10	2				Exhibit R-2a (F	PE 0602602F)
					292						

UNCLASSIFIED

BUDGET ACTIVITY         PE NUMBER AND TITLE         PROJECT NUMBER AND TITLE           002 Applied Research         0602602F Conventional Munitions         PROJECT NUMBER AND TITLE           2500 Ordnance Technology         FY 2006         FY 2007         FY 2008         FY 2008           (1) B. Accomplishments/Planned Program (S in Millions)         FY 2006         FY 2006         FY 2008         FY 2008 <th></th> <th>Exhibit R-2a, RDT&amp;E Project Justi</th> <th>fication</th> <th></th> <th>DATE</th> <th>February</th> <th>2007</th>		Exhibit R-2a, RDT&E Project Justi	fication		DATE	February	2007	
<ul> <li>provide both higher blast performance and lower ignition sensitivity for air-delivered munitions. These technologies will enable safer, more insensitive to unplanned stimuli, and less expensive explosive fills for inventory and future weapons.</li> <li>(U) In FY 2006: Developed highly energetic material with twice the power density of conventional explosives by developing and shinding new energetic signition parameters. Demonstrated use of multi-functional material or nano energetic fills. Fabricated cast/oure Plastic Bonded Explosives (PBX) using advanced materials, plasticizers, and formulation techniques.</li> <li>(U) In FY 2007: Continue developing highly energetic material with twice the power density of conventional explosives by delivering a modeling and simulation capability for enhanced blast materials. Develop energetic linet technology to enhance of tast/cure PBX using advanced materials. Develop energetic linet technology to enhance of activure PBX using advanced materials.</li> <li>(U) In FY 2008: Continue developing highly energetic material with twice the power density of conventional explosives by formulating advanced energetic materials. Evaluate the sensitivity and detonation performance and develop from sping processes for formulations. Characterize the chemical reaction kinetics of new energetic formulations. Evaluate the sensitivity and detonation performance and develop process of new energetic materials. Continue developing a material sproperties database.</li> <li>(U) In FY 2009: Continue developing highly energetic materials. Evaluate the sensitivity and devolor process of new energetic formulations. Evaluate the sensitivity and detonation performance and develop process of new energetic formulations. Evaluate the sensitivity and devoloring a properties database characterizing chemical reaction kinetics.</li> <li>(U) MAOR THRUST: Investigate and develop advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fize technol</li></ul>				al Munitions				
explosives by developing and validating new energetics ignition parameters. Demonstrated use of multi-functional material or nano energetic fills. Fabricated cast/cure Plastic Bonded Explosives (PBX) using advanced materials, plasticizers, and formulation techniques. (U) In FY 2007: Continue developing highly energetic material with twice the power density of conventional explosives by delivering a modeling and simulation capability for enhanced blast materials. Develop energetic liner technology to enhance blast output yet improve the insensitive munition attributes of the weapon system. Demonstrate performance of cast/cure PBX using advanced materials, plasticizers, and formulation techniques. (U) In FY 2008: Continue developing highly energetic material with twice the power density of conventional explosives by formulating advanced energetic informations. Characterize the chemical reaction kinetics of new energetic materials to develop a materials properties database. (U) In FY 2009: Continue developing highly energetic materials to develop a materials properties database. (U) In FY 2009: Continue developing highly energetic materials to develop a materials properties database. (U) In FY 2009: Continue develop process of new energetic materials. Continue developing a materials properties database characterizing advanced explosive formulations. Evaluate the sensitivity and detonation performance and develop advanced fuze technologies for air-delivered munitions, such as commercially available micro-mechanical systems, shock-hadrened fuzes, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and affe-aming components. These advanced fuze technologies will enhalting they precise selection of usrt-height at above, or below the surface to increase weapon safety and tactical performance, while simultaneously decreasing procurement costs and system supportability requirements. (U) In FY 2006: Demonstrated a high resolution, ele	(U)	provide both higher blast performance and lower ignition sensitivity for air-delivered technologies will enable safer, more insensitive to unplanned stimuli, and less expense		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>conventional explosives by delivering a modeling and simulation capability for enhanced blast materials. Develop energetic liner technology to enhance blast output yet improve the insensitive munition attributes of the weapon system. Demonstrate performance of cast/cure PBX using advanced materials, plasticizers, and formulation techniques.</li> <li>(U) In FY 2008: Continue developing highly energetic material with twice the power density of conventional explosives by formulating advanced energetic formulations. Characterize the chemical reaction kinetics of new energetic materials to develop a materials properties database.</li> <li>(U) In FY 2009: Continue developing highly energetic material with twice the power density of conventional explosives by characterizing advanced explosive formulations. Evaluate the sensitivity and detonation performance and develop process of new energetic materials. Continue developing a materials properties database characterizing chemical reaction kinetics.</li> <li>(U) MAJOR THRUST: Investigate and develop advanced fuze technologies for air-delivered munitions, such as commercially available micro-mechanical systems, shock-hardened fuze, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fuze technologies will enhance lethality through precise selection of burst-height at, above, or below the surface to increase weapon safety and tactical performance, while simultaneously decreasing procurement costs and system supportability requirements.</li> <li>(U) In FY 2006: Demonstrated a high resolution, electromagnetic countermeasure-hardend, active imaging fuze that calculates warhead burst direction and detonation time. Developed a minitarized fuze to provide safe and arm, burst point sensor, and low power initiation in a four cubic inch package. Developed a wireless communication system to fuze a hard target munition. Deve</li></ul>		explosives by developing and validating new energetics ignition parameters. Demons multi-functional material or nano energetic fills. Fabricated cast/cure Plastic Bonded I	trated use of					
<ul> <li>conventional explosives by formulating advanced energetic materials. Evaluate the sensitivity and detonation performance and develop design processes for new energetic formulations. Characterize the chemical reaction kinetics of new energetic materials to develop a materials properties database.</li> <li>(U) In FY 2009: Continue developing highly energetic material with twice the power density of conventional explosives by characterizing advanced explosive formulations. Evaluate the sensitivity and detonation performance and develop process of new energetic materials. Continue developing a materials properties database characterizing chemical reaction kinetics.</li> <li>(U)</li> <li>(U) MAJOR THRUST: Investigate and develop advanced fuze technologies for air-delivered munitions, such as commercially available micro-mechanical systems, shock-hardened fuzes, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fuze technologies will enhance lethality through precise selection of burst-height at, above, or below the surface to increase weapon safety and tactical performance, while simultaneously decreasing procurement costs and system supportability requirements.</li> <li>(U) In FY 2006: Demonstrated a high resolution, electromagnetic contermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Developed a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Developed a wireless communication system to fuze a hard target munition. Developed waveform agile</li> </ul>	(U)	conventional explosives by delivering a modeling and simulation capability for enhand Develop energetic liner technology to enhance blast output yet improve the insensitive attributes of the weapon system. Demonstrate performance of cast/cure PBX using ac	ced blast materials. e munition					
<ul> <li>(U) In FY 2009: Continue developing highly energetic material with twice the power density of conventional explosives by characterizing advanced explosive formulations. Evaluate the sensitivity and detonation performance and develop process of new energetic materials. Continue developing a materials properties database characterizing chemical reaction kinetics.</li> <li>(U) MAJOR THRUST: Investigate and develop advanced fuze technologies for air-delivered munitions, such as commercially available micro-mechanical systems, shock-hardened fuzes, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fuze technologies will enhance lethality through precise selection of burst-height at, above, or below the surface to increase weapon safety and tactical performance, while simultaneously decreasing procurement costs and system supportability requirements.</li> <li>(U) In FY 2006: Demonstrated a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Developed a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Developed a wireless communication system to fuze a hard target munition. Developed waveform agile</li> </ul>	(U)	conventional explosives by formulating advanced energetic materials. Evaluate the se detonation performance and develop design processes for new energetic formulations	nsitivity and Characterize the					
<ul> <li>(U) MAJOR THRUST: Investigate and develop advanced fuze technologies for air-delivered munitions, such as commercially available micro-mechanical systems, shock-hardened fuzes, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fuze technologies will enhance lethality through precise selection of burst-height at, above, or below the surface to increase weapon safety and tactical performance, while simultaneously decreasing procurement costs and system supportability requirements.</li> <li>(U) In FY 2006: Demonstrated a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Developed a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Developed a wireless communication system to fuze a hard target munition. Developed waveform agile</li> <li>R-1 Line Item No. 12</li> </ul>		In FY 2009: Continue developing highly energetic material with twice the power dem conventional explosives by characterizing advanced explosive formulations. Evaluate and detonation performance and develop process of new energetic materials. Continu	sity of the sensitivity					
<ul> <li>such as commercially available micro-mechanical systems, shock-hardened fuzes, low energy detonators, light activated and modular firing systems for advanced single-point initiation, switches, capacitors, power sources, and safe-arming components. These advanced fuze technologies will enhance lethality through precise selection of burst-height at, above, or below the surface to increase weapon safety and tactical performance, while simultaneously decreasing procurement costs and system supportability requirements.</li> <li>(U) In FY 2006: Demonstrated a high resolution, electromagnetic countermeasure-hardened, active imaging fuze that calculates warhead burst direction and detonation time. Developed a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Developed a wireless communication system to fuze a hard target munition. Developed waveform agile</li> <li>R-1 Line Item No. 12</li> </ul>								
fuze that calculates warhead burst direction and detonation time. Developed a miniaturized fuze to provide safe and arm, burst point sensor, and low power initiator in a four cubic inch package. Developed a wireless communication system to fuze a hard target munition. Developed waveform agile R-1 Line Item No. 12	(U)	such as commercially available micro-mechanical systems, shock-hardened fuzes, low detonators, light activated and modular firing systems for advanced single-point initia capacitors, power sources, and safe-arming components. These advanced fuze technol enhance lethality through precise selection of burst-height at, above, or below the surf weapon safety and tactical performance, while simultaneously decreasing procurements.	energy tion, switches, logies will ace to increase	7.300	7.050	5.600	6.000	
	(U)	In FY 2006: Demonstrated a high resolution, electromagnetic countermeasure-harder fuze that calculates warhead burst direction and detonation time. Developed a miniate provide safe and arm, burst point sensor, and low power initiator in a four cubic inch Developed a wireless communication system to fuze a hard target munition. Develop	nrized fuze to backage. led waveform agile					
	Proi					Exhibit R-20 (		

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602602F Conventi			MBER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	fuze to defeat smart jamming devices.					
(U)	In FY 2007: Continue developing a miniaturized fuze to provide safe and arm,	-				
	low power initiator in a four cubic inch package. Continue developing a wirel					
	system to fuze a hard target munition. Continue to develop a waveform agile f	uze to defeat smart				
	jamming devices.					
(U)	In FY 2008: Test a miniaturized fuze to provide safe and arm, burst point sens	-				
	in a four cubic inch package. Complete static and sled testing of a wireless cor	•				
	fuze a hard target munitions. Complete development of a waveform agile fuze	to defeat smart jamming.				
	Begin investigating novel warheads to initiate explosives.					
(U)	In FY 2009: Demonstrate a miniature fuze that provides safe and arm, burst po	_				
	initiator in a four cubic inch package. Continue investigating novel methods to	-				
(TI)	Begin investigating miniature components to transmit bomb damage information	on.				
(U)	MAJOD TUDUCT. Investigate and develop control and corriges technologies	for ordnance posteroos	11.067	16 101	12 402	0 000
(U)	MAJOR THRUST: Investigate and develop control and carriage technologies for advanced air-delivered munitions in order to enhance weapon lethality. Ex.	1 0	11.067	16.181	12.403	8.800
	technologies include high-energy formulations, mass-focus fragmentation, and	<b>1</b>				
	These technologies will increase weapon systems effectiveness by contributing	•				
	load-out on strike aircraft and enhanced sortie effectiveness. Note: In FY 2007					
	support Battlefield Air Operations efforts.	, funds are increased to				
(U)	In FY 2006: Investigated precise time-of-arrival munitions. Identified critical t	technologies needed for				
(0)	an advanced next generation, low-cost miniature cruise missile. Investigated te	-				
	operations through loitering, persistent, low-cost, multiple-shot munitions. Investigated to	- · ·				
	nanotube-reinforced composites to reduce structural weight of weapons. Devel	-				
	attack system to communicate target aim point position from behind enemy lin	-				
	video capability to collect and transmit data to coordinate attack of enemy target	-				
(U)	In FY 2007: Complete precision time-of-arrival investigation to defeat tunnel					
	investigating technologies for miniature cruise missile development. Finish the					
	loitering, persistent, low-cost multiple-shot munitions. Finish the initial investi	gation of nanotube				
	reinforced composites to reduce structural weight of weapons. Continue miniat	urizing the attack system				
	to communicate target aim point position from behind enemy lines. Continue to	o develop a covert video				
	capability to collect and transmit data to coordinate attack of enemy targets.					
(U)	In FY 2008: Finish investigating technologies for miniature cruise missile dev	elopment. Finish				
	D 1	Line Item No. 12				
_	ject 2502	Page-8 of 10			Exhibit R-2a (I	

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	ET ACTIVITY oplied Research	PE NUMBER AND TITLE 0602602F Convention	al Munitions		IBER AND TITLE	ду
r I t	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> miniaturizing the attack system to communicate target aim point position from behind Field test a covert video distribution capability to collect and transmit data to coordin targets. Investigate reaction jet control technology to enable dual role air dominance Begin to investigate the design of precision guided munitions.	ate attack of enemy	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
c C F	In FY 2009: Integrate new technology solutions into a covert video distribution capa data to coordinate attacks of enemy targets. Continue investigating reaction jet contro- dominance missile technology. Continue investigating the design of precision guided performing subsystem design trade studies.	ol for dual role area				
v i æ r	MAJOR THRUST: Investigate and develop advanced warhead kill mechanisms, suc warhead, directional control and fragmenting ordnance, and application of reactive m nvestigation includes characterization of the dynamic response of metals and geolog adjustable yield ordnance packages, and distributed multi-point fire set to enhance air nunition lethality. This enhanced lethality supports the development of smaller mun effectiveness similar to current inventory weapons with a corresponding increase in a sortie effectiveness.	etals. The ic materials, -delivered itions with	8.264	7.448	8.100	7.766
f c I	In FY 2006: Demonstrated an ordnance package designed for low collateral damage far-field lethality. Completed in-house effort to improve penetrating warhead case su of burial, and trajectory control with lower case thickness. Evaluated selected materi penetrating weapons. Developed focusing kill mechanisms for dual role, dual range n investigated micro damage technologies to neutralize electronics with small robotic v	rvivability, depth als for high-speed nissiles.				
e	In FY 2007: Continue evaluating selected materials for high-speed penetrating weap effort to develop focusing kill mechanisms for dual role, dual range missiles. Continuitor damage technologies to neutralize electronics with small robotic weapons.					
(U) I r v r	In FY 2008: Continue evaluating selected materials for high-speed penetrating weap nose-caps against hard and combination targets. Begin investigating high strength ne warhead cases with the eventual goal of terradynamic steering. Evaluate shaped char medium and heavy armor. Continue investigating micro-damage technologies to neu with small robotic weapons. Develop a small high velocity unmanned aerial vehicle with strength to defeat hardened targets. Develop a submunition concept that can per arget for agent defeat.	ext generation ges to defeat tralize electronics (UAV) deliverable				
(U) I	In FY 2009: Complete evaluation of selected materials for high-speed penetrating we					
Proje		9 of 10			Exhibit R-2a (F	PE 0602602F)

		Exhibit	: R-2a, RD	T&E Projec	t Justificat	tion			DATE	February	2007
	GET ACTIVITY Applied Research					JMBER AND TIT 2602F Conve	TLE ntional Munitic		PROJECT NUMBE	R AND TITLE	
(U)	nose-caps against hard and com warhead cases with the eventual to defeat medium and heavy arr electronics with small robotic w with strength to defeat hardened agent defeat mechanisms against	bination targets l goal of terrady nor. Continue i yeapons. Contir l targets. Contir	. Continue inv namic steering nvestigating m ue developing nue investigati	g. Continue eva icro-damage te a small high v	aluation of shap echnologies to relocity UAV d	bed charges neutralize eliverable	<u>FY 200</u>	6	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Total Cost						39.458	8	43.979	39.913	38.066
(U) (U)	C. Other Program Funding Su Related Activities: PE 0603601F, Conventional Weapons Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Pro	oject 2502			I	R-1 Line Item No. Page-10 of 10					Exhibit R-2a (F	2E 0602602F)
				L	296 J <b>NCLASSIFI</b>	ED					

#### PE NUMBER: 0602605F PE TITLE: DIRECTED ENERGY TECHNOLOGY

	Exhibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
UDGET ACTIVITY 2 Applied Research					IBER AND TITL D5F DIRECT	E ED ENERGY	TECHNOL	OGY		
Cost ( <sup>¢</sup> in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Cost (\$ in Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Co	st 43.287	50.019	54.883	53.362	69.249	58.419	69.307	75.617	Continuing	TE
866 Lasers & Imaging Technology	28.795	25.124	33.584	31.954	42.985	35.715	42.897	47.041	Continuing	TH
867 Advanced Weapons & Survivability Technology	14.492	15.424	16.396	16.261	20.520	17.227	20.980	23.031	Continuing	TE
5SP Laser and Imaging Space Tech	0.000	9.471	4.903	5.147	5.744	5.477	5.430	5.545	0.000	0.0
J) <u>A. Mission Description and Budge</u> This program covers research in dir (solid state and chemical) and assoc wideband high power microwave de Congress added \$1.8 million for Ce and determines the technical feasibi	ected energy tec iated optical con vices and anten camics for Next	hnologies, prir nponents and t nas. Both area Generation Ta	echniques. In s also provide ctical Laser S	advanced we vulnerability, ystems. This	apons, this pro /lethality asses program is in	ogram examine ssments of rep	es technologie resentative sy	es such as narr stems. Note:	owband and In FY 2007,	
U) <u>B. Program Change Summary (\$</u>	in Millions)				<u>FY 20</u>		<u>FY 2007</u>		2008	<u>FY 2009</u>
J) Previous President's Budget					44.1		48.422		3.340	54.252
J) Current PBR/President's Budget					43.2		50.019	5.	4.883	53.362
J) Total Adjustments					-0.8	82	0.014			
J) Congressional Program Reductions Congressional Rescissions							-0.014 -0.189			
Congressional Increases							4.300			
Reprogrammings					-0.0	88	-2.500			
SBIR/STTR Transfer					-0.7		2.300			
J) <u>Significant Program Changes:</u>					0.7					
Not Applicable.										
C. Performance Metrics Under Development.										

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY oplied Research				06026	IBER AND TITL 05F DIRECT NOLOGY			ROJECT NUMBE	ER AND TITLE Imaging Te	chnology
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
10.66		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4866		28.795	25.124	33.584	31.954	42.985	35.715	42.897	47.041	Continuing	TBD
Note	Quantity of RDT&E Articles In FY 2008, relay mirror technology	0	Ű	ş	ů.	ů	ţ	ů	ş	I fer to this proje	Let to
	effectively manage the efforts.	enons previou	siy periorinee	i ili i loject 55	, Lasers and	a maging spe	ice reennoiog	y, within this		er to uns proje	
	A. Mission Description and Budget This project explores the technical feat engagement, and Global War On Terr development of: (1) compact, reliable and beam control systems to enhance modeling and simulation and laborato requirements unique to potential appli performance, military utility and cost	sibility of mod orism missions , and affordabl laser beam pro ry experiments cations. Deve	lerate to high s. Develop ne e laser system pagation and s to demonstra lop and imple	w technologies with good b pointing and t te traceability	es, perform ph beam quality, s tracking over 1 7 to key concep	ysics based m calability to h ong distances ot performance	odeling, and e igh power, and in the atmospl e parameters,	valuate new i d high potenti here. Empha reliability, aff	naterials that al military uti sis will be on fordability, and	will enable lity; (2) optical using compute 1 packaging	
(U) (U)	<b>B.</b> Accomplishments/Planned Progr MAJOR THRUST: Develop solid sta applications. Technologies include fi In FY 2006: Developed laser compor- electro-optic targets from airborne tac mid-infrared, and long-wavelength op delivery methods. Began developmen Assessed laser requirements for destra assessment studies of the various lase assessment models by experiments. I gain media. Demonstrated greater tha technologies to obtain architectures the and fieldability for tactical laser weap In FY 2007: Design and develop lase increased efficiency and reliability. F potential applications. Continue develop	ate laser technologies technologies and hent technologies	blogies for airl bulk solid stat ies for detectin s. Enhanced n loped single- to aero-optica s in the threat elevant scenar d demonstrate a wavelength le in terms of s. amming/dama g of ultra-shor utions to aero	e lasers. ng, identifying ew laser struct and multi-wa l issues on ain sensors. Perf tios. Validate ed alternative n versatile lase size, weight, of ging optical t t pulse laser s -optical issue	g, tracking, and ctures for near- velength packa borne platform ormed lethality d vulnerability laser architectt er. Refined las efficiency, affo hreats, focusin ources to evalu s on airborne p	infrared, aging and ns. y ures and ser ordability, g on uate olatforms.	<u>FY 20</u> 11.4		<u>Y 2007</u> 13.320	<u>FY 2008</u> 15.547	<u>FY 2009</u> 15.500
	Investigate technologies for tactical p implementation of advanced techniqu		-	t technologies R-1	•	er handheld				Exhibit R-2a (P	E 0602605F)
<u> </u>					298					```	

Exhibit R-2a, RDT&E	Project Justification		DAT	E February	2007		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTEI TECHNOLOGY	D ENERGY		ECT NUMBER AND TITLE Lasers & Imaging Technology			
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> systems. Perform additional lethality assessment studies of the vari scenarios. Continue to validate vulnerability assessment models. R architectures that are favorable in terms of size, weight, efficiency, tactical laser weapon applications. Develop the most promising sol to the weapons class power level. Demonstrate "eye-safe" wavelen designator and illuminator applications.	efine technologies to obtain affordability, and fieldability for d state laser technologies for scaling	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
<ul> <li>(U) In FY 2008: Refine laser sources to obtain higher efficiencies and it Continue development of system-level solutions to aero-optical issue weapon applications. Perform further lethality assessment studies to various laser concepts in relevant scenarios. Continue coupon-level experiments to validate vulnerability assessment models. Continue weapons class power level. Refine technologies in effort to obtain a weight, efficiency, affordability, reliability, maintainability, support (air, land, and maritime), and ruggedness for the next-generation ap</li> <li>(U) In FY 2009: Improve design of laser sources for jamming/damagin tests against real or simulated advanced threat systems and use test effectiveness. Increase efficiencies and improve ruggedness of desi system-level solutions to aero-optical issues of tactical laser weapon</li> </ul>	es involving airborne tactical laser o assess the effectiveness of the and mid-scale demonstration to scale electric lasers up to the uitable parameters in terms of size, ability, environmental acceptability plications. g optical threats. Perform damage results to verify models and laser gns. Conclude development of						
with goal of procurement of representative beam delivery sub-syste studies to assess the effectiveness of the various laser concepts in re coupon-level and mid-scale demonstration experiments to validate Continue to scale electric lasers up to the weapons class power leve (U)	levant scenarios. Perform vulnerability assessment models.						
(U) MAJOR THRUST: Develop chemical, gas, and hybrid laser technor regeneration techniques, and nozzle designs) for scalable, high ener efficiency for insertion into airborne platforms and ground based last	gy laser devices with improved	4.673	4.885	6.074	5.470		
(U) In FY 2006: Continued to investigate the scalability of high perform oxygen generator concepts for airborne laser applications. Demons electrical singlet oxygen generator technology to help improve curry Investigated fiber pumped molecular gas lasers. Developed advance	nance zero-gravity singlet delta rated advanced chemical and ent levels of performance. ed diagnostics for chemical oxygen						
iodine laser performance measurements to identify potential enhance	ements. Began work on						

	Exhibit R-2a, RDT&E Proje	ect Justification		DATI	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602605F DIRECTE TECHNOLOGY			MBER AND TITLE S & Imaging T		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> technologies that would increase the range of future high power airborne la chemical-electrical hybrid laser technologies that offer potential for power and weight reduction.	•	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Continue to investigate scaling of high-performance oxygen g airborne laser applications. Evaluate iodine injection schemes for oxygen g refine advanced chemical laser technologies demonstrated in FY 2006. Put hybrid laser technologies that offer potential for power scaling and comport reduction.	generators. Evaluate and rsue scaling chemical-electric					
(U)	In FY 2008: Demonstrate enhanced-performance singlet delta oxygen gen ejector nozzle concepts for airborne laser applications, including advanced scaling path demonstrations for electric discharge oxygen-iodine lasers and	fuel chemistries. Continue					
(U)	In FY 2009: Refine high-performance singlet delta oxygen generator and a concepts for airborne laser applications based on results of previous demon condition demonstrations for electric discharge oxygen-iodine lasers and di	ndvanced ejector nozzle stration. Begin real-world					
(U)							
(U)	MAJOR THRUST: Develop optical and imaging technologies for advanced compensation, and pointing and tracking for future optical imaging/laser sy relay mirror technology efforts previously performed in Project 55SP, Lase Technology, within this PE were placed here to more effectively manage the	vstems. Note: In FY 2008, or and Imaging Space	5.787	5.126	11.963	10.984	
(U)	In FY 2006: Began development of component-level and system-level solution involving tactical laser applications on airborne platforms; analyzed most platforms. Continued aero-optical wavefront sensor development. Evaluated unit improvements. Continued testing of tactical beam control propagation towards demonstration of high-bandwidth active tracking of uncooperative investigated advanced adaptive optics for relay mirror uplink beam control two beam propagation techniques for tracking and illumination of a cruise relay mirror. Continued design of low-altitude relay mirror field experiment advanced sodium-beacon adaptive optics system on 3.5 meter telescope.	promising concepts for field advanced inertial reference a codes. Continued working targets. Simulated and . Developed and evaluated missile through an airborne nts. Began testing of					
(U)	In FY 2007: Continue development of system-level solutions to aero-optic laser applications on airborne platforms and acquire adaptive optics system disturbance mitigation testing. Investigate technologies for tracking in clut	for wind tunnel aero-optics					
	ject 4866	R-1 Line Item No. 13 Page-4 of 15			Exhibit R-2a (		

	Exhibit R-2a, RDT&E Project Just	ification		DATE Februar	y 2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERG TECHNOLOGY		PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Techr		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> disturbance mitigation. Develop selected technologies for transition from laboratory Continue investigation of advanced adaptive optics techniques. Demonstrate detecti discrimination of small, nonresolved space objects using sodium-beacon adaptive op	on and	006 <u>FY 20</u>	007 <u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Integrate adaptive optics hardware in wind tunnel tests to measure and aero-optical disturbances. Develop and analyze advanced tactical beam control arch beam control components, such as inertial references and trackers. Begin developmed optics and advanced tracking techniques and technologies. Complete sub-system fail conduct a low-power demonstration. Begin development of a 25 kilowatt laser for in relay mirror system. Begin integration of sodium beacon with high efficiency adapti	itectures and critical ent of lightweight prication in order to ntegration into the				
(U)	In FY 2009: Complete demonstration of southin occuron with high efficiency datapart in FY 2009: Complete demonstration of system-level solutions to aero-optical disto with airborne tactical laser weapons systems in wind-tunnel environment. Implement disturbance initiative-readied technologies as component of end-to-end field demons laser control. Continue further concept lethality assessments. Provide system concer- support for an integrated ground tactical demonstration. Demonstrate closed loop tra- conjunction with sensor systems as part of continued development and integration of breadboard system. Demonstrate compensated imaging and detection of very dim sp visible wavelengths. Integrate and demonstrate advanced tactical beam control syste- beam control components, such as inertial references and trackers. Continue develop optics and advanced tracking techniques and technologies. Conduct a low-power de Integrate a 25 kilowatt laser with the relay mirror to demonstrate the laser-mirror sys- sodium beacon with high efficiency adaptive optics system.	rtions associated at advanced platform tration of precision pt engineering acking in the relay mirror bace objects at ms and critical oment of lightweight monstration.				
(U) (U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Adaptive Optics Lasercom In FY 2006: Conducted Congressionally-directed effort for Adaptive Optics Laserco In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		421 0.0	000 0.000	0.000	
(U) (U) (U)	CONGRESSIONAL ADD: Advanced Laser Materials Development In FY 2006: Conducted Congressionally-directed effort for Advanced Laser Materia In FY 2007: Not Applicable.		710 0.0	000 0.000	0.000	
Pro	oject 4866 Page	tem No. 13 5 of 15 01		Exhibit R-2a	(PE 0602605F)	

		Exhibit	: R-2a, RD	F&E Projec	t Justifica	tion			DATE		2007
	GET ACTIVITY Applied Research		-,		PE N 0602	UMBER AND TI	TLE TED ENERGY		<b>February 2007</b> CT NUMBER AND TITLE Lasers & Imaging Technology		
(U)	<b>B. Accomplishments/Planned</b>	Program (\$ in	Millions)				<u>FY 20</u>	<u>)6</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Not Applicable.										
(U)	In FY 2009: Not Applicable.										
(U)											
(U)	CONGRESSIONAL ADD: Ce			•			1.74	42	1.793	0.000	0.000
(U)	In FY 2006: Conducted Congre	essionally-direct	ted effort for C	eramics for Ne	ext Generation	Tactical					
	Laser Systems.										
(U)	In FY 2007: Conduct Congress	sionally-directed	l effort for Cer	amics for Next	Generation Ta	ctical Laser					
ar	Systems.										
	In FY 2008: Not Applicable.										
(U)	In FY 2009: Not Applicable.						29.7	) <i>5</i>	25 124	22 594	21.054
(U)	Total Cost						28.7	75	25.124	33.584	31.954
(U)	C. Other Program Funding Su	<u>ımmary (\$ in N</u>	<u>fillions)</u>								
		FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	<u>FY 2012</u>	FY 2013	Cost to	<b>T</b> 10
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate			TOTAL COST
(U)	Related Activities:									- <b>-</b>	
(U)	PE 0601108F, High Energy										
	Laser Research Initiatives.										
(U)	PE 0602500F,										
	Multi-Disciplinary Space										
	Technology.										
(U)	PE 0602890F, High Energy										
	Laser Research.										
(U)	PE 0603444F, Maui Space										
	Surveillance System.										
(U)	PE 0603500F,										
	Multi-Disciplinary Advanced										
	Development Space										
an	Technology. PE 0603605F, Advanced										
(0)	Weapons Technology.										
an	PE 0603924F, High Energy										
(0)	i E 00039241, iligii Elicigy				R-1 Line Item No	13					
Pr	oject 4866			, i	Page-6 of 15	-				Exhibit R-2a (	PE 0602605F)

Exhibit R-2a, RDT&E P	Project Justification	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology
<ul> <li>(U) C. Other Program Funding Summary (\$ in Millions) <ul> <li>Laser Advanced Technology</li> <li>Program.</li> </ul> </li> <li>(U) PE 0603883C, Ballistic <ul> <li>Missile Defense Boost Phase</li> <li>Segment.</li> </ul> </li> <li>(U) This project has been <ul> <li>coordinated through the</li> <li>Reliance 21 process to</li> <li>harmonize efforts and</li> <li>eliminate duplication.</li> </ul> </li> <li>(U) D. Acquisition Strategy <ul> <li>Not Applicable.</li> </ul> </li> </ul>		
Project 4866	R-1 Line Item No. 13 Page-7 of 15 303	Exhibit R-2a (PE 0602605F

		Exhibit R-	2a, RDT&E	E Project .	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY oplied Research				06026	IBER AND TITL 05F DIRECT NOLOGY		Y 48	OJECT NUMBE 67 Advance Irvivability T	d Weapons	&
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4867	Advanced Weapons & Survivability Technology	14.492	15.424	16.396	16.261	20.520	17.227	20.980	23.031	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
e e	A. Mission Description and Budget This project explores high power micro support a wide range of Air Force miss effect can often be applied covertly w as large and small air defense and con systems to HPM weapons, HPM weap	rowave (HPM) ssions such as t ith no collatera nmand and cor	and other und the potential di al structural or atrol systems.	isruption and human dama This project a	degradation of ge. Targeted of also provides f	f an adversary capabilities ind for vulnerabilities	's electronic in clude local con ty assessments	nfrastructure a mputer and co s of representa	nd military ca mmunication tive U.S. strat	pability. This systems, as we egic and tactic	ell
(U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Investigate and c components to support multiple Air F subsystems.	levelop techno	logies for narr				<u>FY 20</u> 6.4		<u>¥ 2007</u> 4.015	<u>FY 2008</u> 4.821	<u>FY 2009</u> 4.445
(U)	In FY 2006: Developed a compact re conformal high power phased array a permanent magnets for the compact p system to drive the HPM source. Con HPM demonstration unit. Developed airborne platform. Developed compa Developed target identification algorid determine optimal design.	ntenna for the pulsed gigawath nducted labora vacuum syste ct solid-state v thms. Conduct	compact pulse t HPM source. tory measuren ms that are convideband source videband source ted target iden	d HPM sourc Developed a nents of the co mpact and car ce and antenna tification field	e. Developed a compact pulse ompact pulsed a be installed i a for target ide l experiments	compact se power gigawatt n an entification. to					
(U)	In FY 2007: Conduct measurements demonstration unit. Improve the com- integrated into an airborne platform. HPM unit. Implement nanotechnolog of a mesoband unit that will character Develop an engineering model of a co- conduct laboratory experiments for ap In FY 2008: Continue testing of the c- unit. Continue to improve the compa-	pact HPM sou Develop a con gy to reduce the rize the system ompact wideba oplications suc compact repeti	rce and confor- nmand and con- e HPM source and demonstr and target iden h as target unc tively pulsed g	rmal antenna f ntrol system for weight and si- rate the effecti- tification syst- ler trees. gigawatt-class	that they can be or the airborne ize. Conduct f veness of the em that can be HPM demons	be e platform field tests system. e used to stration					
Proje	et 4867				Line Item No. 1 Page-8 of 15 304	3				Exhibit R-2a (P	E 0602605F)

	Exhibit R-2a, RDT&E Proj	ect Justification		DATE	E February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602605F DIRECTE TECHNOLOGY	D ENERGY	4867 Advan	MBER AND TITLE nced Weapons & ty Technology		
(U) (U)	demonstrate the conformal antenna and command and control system for	s program. Further develop rform functional testing. Igle shot devices. Perform If testbed. Integrate and the compact HPM testbed.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	Improve the wideband antenna and high voltage switch and demonstrate t tests.	he effectiveness during field					
(U)	MAJOR THRUST: Develop and use the ability to assess the effects/letha weapon technologies against representative air and ground systems. Deve models to enhance the development of HPM and related technology.		3.925	4.478	5.315	5.607	
(U)	In FY 2006: Continued to advance elemental modeling methodology to p Developed advanced descriptions of target functional behavior for insertion simulation codes. Continued susceptibility testing of electronic targets. W dielectric pulse power interfaces and antenna breakdown. Improved the fi- electromagnetic models by statically refining the numerical grid and by har solution. Continued integration of electromagnetic codes with thermal an	on into modeling and Validated plasma model on idelity of the solution to aving a boundary conformal d electron transport codes.					
(U)	Conduct further experiments on the systems to verify model accuracy and experiments. Adjust models as required. Identify and mitigate platform s and associated electromagnetic interference/compatibility considerations to preliminary battle damage assessment system for HPM sources. Continue electronic targets. Apply hardening techniques to identified platforms. Ic susceptibility for military systems against both domestic and foreign source electromagnetic codes with thermal and electron transport codes for HPM Begin integration of boundary conformal solutions. Apply plasma model Investigate improved material physics models. Initiate development of au system design.	compare predictions with susceptibility to onboard HPM for fratricide issues. Refine e susceptibility testing of lentify and mitigate HPM ces. Validate integration of sources and components. for high field regions. atomatic optimization for HPM					
(U)	In FY 2008: Incorporate elemental modeling into predictive code for use	in targeting and war gaming. R-1 Line Item No. 13					
Pro	ject 4867	Page-9 of 15			Exhibit R-2a (I	PE 0602605F)	

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602605F DIRECTI TECHNOLOGY		4867 Advan	IBER AND TITLE ced Weapons y Technology	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> Continue susceptibility testing of electronic targets. Apply hardening techniques and identified platforms. Identify and mitigate HPM susceptibility for military systems of sources. Continue to refine preliminary battle damage assessment technologies for u Apply virtual modeling for HPM system enhancement. Validate and document the e adaptive grid generation for HPM system design. Extend the air breakdown model a development to simulate plasma channel formation. Apply boundary conformal meth system enhancement. Continue to investigate and integrate improved material models simulations. Continue development of automatic design enhancement.	f interest to HPM se with HPM. fficacy of automatic lready in nods to HPM	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	in FY 2009: Continue susceptibility testing of electronic targets to refine modeling to and enhance modeling and simulation software to account for new developments. Co susceptibility work and apply hardening technology to platforms. Continue applicati modeling for HPM system enhancement. Begin integration of adaptive grid generati HPM system simulations. Using boundary conformal methods to perform HPM syste Apply improved material physics models to HPM system enhancement. Apply autor to HPM tube design.	ontinue platform on of virtual on methods into em enhancement.				
(U) (U)	MAJOR THRUST: Investigate HPM technologies that support offensive and force p tactical applications, including non-lethal counterpersonnel applications, made possil power available on future aircraft.		4.150	6.931	6.260	6.209
(U)	In FY 2006: Refined HPM system source code to reflect payload to platform integra thermal, x-ray, and electrical issues. Examined the status of power conditioning subs determine their applicability to an airborne experiment. Ensured understanding of air potentials given specific antenna interfaces. Continued refinement of solid state subs Continued refinement of solid state pulsed power subsystem designs.	ystems to breakdown				
(U)	In FY 2007: Further develop HPM source materials and assess applicability of solid designs supporting ruggedized high power airborne and counter-improvised explosive Extend HPM system source code to reflect multiple options for high power subsystem Refine antenna concepts to meet airborne requirements for counter electronics include issue related to propagation, air breakdown, and radomes. Mature relativistic magner Refine existing beam control/antenna concepts to meet airborne requirements include related to propagation, breakdown, and radomes. Research, study and identify technology and the propagation of the pr	re device systems. In components. Ing addressing fron technologies. Ing addressing issue plogy or data				
Pro	· · · · · · · · · · · · · · · · · · ·	0 of 15			Exhibit R-2a (I	PE 0602605F)
	3	06				

		Exhibit	R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007
	GET ACTIVITY Applied Research				0602	UMBER AND TI 2605F DIREC HNOLOGY	TLE TED ENERG	iY 4	ROJECT NUMBE 867 Advanced urvivability T	d Weapons	s &
(U)	<b><u>B. Accomplishments/Planne</u></b> (effects, safety, stabilization, e	engagement) requ	irements impa	-	irborne concept	tual approach,	<u>FY 2</u>	<u>006 I</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	including non-lethal. Refine r In FY 2008: Continue develo subsystem designs supporting systems. Analyze the results r power subsystem components counter electronics and counter to propagation, breakdown, ar	pment of HPM so ruggedized high from the HPM sys . Continue to refi er-improvised exp nd radomes. Cont	purce materials power airborne stem source co ne antenna co losive device s inue developm	and assess appeand counter-ide that reflects neepts to meet systems includient of full pow	mprovised exp multiple optio airborne requir ing addressing ver non-lethal t	losive device ns for high rements for issues related est source					
(U)	and technology studies for con In FY 2009: Implement matu subsystem designs supporting systems. Implement the enhan- the HPM system source code. counter electronics and counter to propagation, breakdown, ar Continue non-lethal beam com	ring HPM source ruggedized high nced options for h Implement the a er-improvised exp nd radomes. Com	materials and power airborne igh power sub ntenna design losive device s plete developr	assess the appl e and counter-i system compo that best meets systems includ nent of full pow	icability of solution mprovised exp nents based on a airborne requising addressing wer non-lethal	id state losive device the results of rements for issues related test source.					
(U)	Total Cost						14.4	492	15.424	16.396	16.261
(U) (U)	C. Other Program Funding S Related Activities: PE 0602202F, Human Systems Technology. PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	Summary (\$ in <u>N</u> <u>FY 2006</u> <u>Actual</u>	<u>IIIIons)</u> <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>	Total Cost
Pro	ject 4867				R-1 Line Item No Page-11 of 15 <b>307</b>					Exhibit R-2a (I	PE 0602605F)

Exhibit R-2a	a, RDT&E Project Justification	DATE February 2007
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4867 Advanced Weapons & Survivability Technology
U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.		
Project 4867	R-1 Line Item No. 13 Page-12 of 15	Exhibit R-2a (PE 0602605)
	308 UNCLASSIFIED	

	Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
BUDGET ACTIVITY 02 Applied Research				06026	05F DIRECT					pace Tech
Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Exhibit R-2a, RD1 & Project JustificationFebruary 2007BUDGET ACTIVITYPROJECT NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGYPROJECT NUMBER AND TITLE 55SP Laser and Imaging Space Tech02 Applied ResearchPY 2006 						0.000				
								1	0.000	0.000
		~		Ů	ţ	-		-	Space Tech	to this
<ul> <li>Project 4866, Lasers and Imaging Technolo</li> <li>(U) A. Mission Description and Budget Develop advanced, long-range, optica pointing; large, lightweight optics; and high-energy laser weapons and update</li> </ul>	ogy, to this pro Item Justifica Il technologies d optical coatin e catalogued sa	ject to more en tion such as advan ngs that suppo tellites.	ffectively mar	nage the effort	s. quisition, track	king, and point	ting; adaptive herability of s	optics; dual li atellites to the	ne-of-sight effects of	
<ul> <li>MAJOR THRUST: Develop advance control; beam acquisition, tracking, a lightweight optics; and optical coating 2008, relay mirror technology efforts 4866, Lasers and Imaging Technolog</li> </ul>	ed, long-range, nd pointing; ac gs that support previously per	optical techno laptive optics; future space-o formed in this	dual line-of-s object imaging s major thrust	sight pointing; g systems. No will be moved	large, ote: In FY l to Project					<u>FY 2009</u> 2.824
<ul> <li>(U) In FY 2007: Begin investigations in a relay mirror. Complete development and beam projection. Continue invest control. Investigate designs for tactic Begin procurement of long lead optic telescopes for integration into a bread experiment in the presence of atmosp orbit angular validation momentum e for secure high bandwidth communic</li> <li>(U) In FY 2008: Understand the bandwidt concepts, correlate the attributes to us</li> </ul>	of first genera tigation of adv cal relay mirror al components lboard relay mi- heric disturbar xperiment and ations. Conclu- th, movement ser needs to inco- periment. Com s imaging and	tion advanced anced adaptiv s for propagat to include tra irror payload. nees without th establish a res ide the develo , and resolutio clude aero-option plete a low po beam projecti	wavefront co e optics techn ion of laser er nsmitting and Perform phas he aid of a retri- search approace pment of light n limits of var- ic compensation ower phased a on with wide ngular momen	ntrol device for iques for uplin nergy through receiving bea sed array imag ro-reflector. P ch to advance tweight mirror rious adaptive on, and demon rray transceive field of regard	or imaging hk beam turbulence. m director ing erform a concept rs. optics hstrate a er beam ication and					
Project 55SP				Page-13 of 15	-				Exhibit R-2a (P	E 0602605F)
				309	_					

	Exhibit R-2a, RDT&E Project Ju			DATI	February	2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602605F DIRECTE TECHNOLOGY	D ENERGY		IBER AND TITLE and Imaging	ER AND TITLE nd Imaging Space Tech		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> began experimental validation with continued modeling and theoretical investigat		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	In FY 2009: Develop advanced adaptive optic components and evaluate system i those components. Continue to work on the orbital angular momentum communi	-						
(U) (U)	MAJOR THRUST: Assess the vulnerability of satellites to the effects of high-en- update catalogued satellites.	ergy laser weapons and	0.000	1.858	2.211	2.323		
(U) (U) (U)	In FY 2006: Not Applicable. In FY 2007: Develop and apply new, improved algorithms and hardware for sate and vulnerability assessment. Continue to update assessment methodology by ind including results of laser illumination, tracking, and compensated imaging, technis survivability and vulnerability of aerospace systems to the effects of directed ener response databases for continued improvement of predictive avoidance analyses a data to U.S. Strategic Command for the performance of Laser Clearinghouse func expand knowledge of space material properties and aging effects. Continue to im capabilities to rapidly fuse sensor data to ascertain the health and status of aerospa- In FY 2008: Explore new methods to develop and apply improved algorithms an characterization and assessment. Continue to refine assessment methodology by	corporating new data, iques. Assess the rgy weapons. Update and continue to provide ctions. Continue to aprove and mature ace systems. d hardware for satellite incorporating new data						
	into modeling tools, including results of laser illumination, tracking, and compense applying new techniques. Assess the survivability and vulnerability of evolving a the effects of directed energy weapons. Integrate developed space material proper data and algorithms into assessments. Continue to improve and mature capabilitie existing sensor data to assess the operational health and status of aerospace syster begin transition of these capabilities to U.S. Strategic Command and other users.	nerospace systems to rties and aging effects es to rapidly fuse ns while working to						
(U)	In FY 2009: Expand analysis capabilities to provide assessments of effects on ae new and emerging directed energy concepts. Continue to refine and broaden asse by incorporating new experimental data from laser illumination, tracking, and con results of space materials properties and aging analysis; and enhanced numerical to assess the survivability and vulnerability of evolving aerospace systems to the energy weapons. Continue to advance the capabilities to rapidly fuse sensor data operational health and status of aerospace systems and continue to transition the r operational users.	essment methodologies npensated imaging; techniques. Continue effects of directed to assess the						
Pro		ne Item No. 13 ge-14 of 15			Exhibit R-2a (I	PE 0602605F)		

		Exhibit	: R-2a, RD	T&E Projec	t Justifica	ition			DATI	February	2007
	GET ACTIVITY Applied Research				060	NUMBER AND TI 2605F DIREC CHNOLOGY				IBER AND TITLE and Imaging	
( <b>U</b> ) (U)	<b><u>B. Accomplishments/Planned</u></b> Total Cost	Program (\$ in	<u>Millions)</u>				<u>FY 2</u> 0.0	<u>006</u> 000	<u>FY 2007</u> 9.471	<u>FY 2008</u> 4.903	<u>FY 2009</u> 5.147
(U)	<u>C. Other Program Funding S</u>	ummary (\$ in N <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> FY 2007 <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate		<u>3 Cost to</u> te Complet	Total Cost
(U) (U) (U) (U) (U)	Related Activities: PE 0602500F, Multi-Disciplinary Space Tech. PE 0603444F, Maui Space Surveillance Systems. PE 0603500F, Multi-Disciplinary Adv Dev Space Technology. PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance 21 process to harmonize the efforts and eliminate duplication. <b>D. Acquisition Strategy</b>				Lounat	Louinate					<u>~</u>
	Not Applicable.				R-1 Line Item N						
Pro	ect 55SP				Page-15 of 1 <b>311</b>					Exhibit R-2a	PE 0602605F

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#### PE NUMBER: 0602702F PE TITLE: Command Control and Communications

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	- ebruary 2	2007		
	DGET ACTIVITY       PE NUMBER AND TITLE         Applied Research       0602702F Command Control and Communications												
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total		
	Total Program Element (PE) Cost	95.676	128.680	116.705	105.496	128.069	111.838	115.121	119.628	Continuing	TBD		
4519	Communications Technology	23.987	29.273	27.458	27.126	35.448	24.788	29.305	31.385	Continuing	TBD		
4594	Information Technology	26.879	33.581	32.154	31.691	33.502	31.544	33.735	34.979	Continuing	TBD		
5581	Command and Control (C2) Technology	44.810	49.696	39.876	35.584	49.132	45.263	42.076	43.071	Continuing	TBD		
66SP	Space Optical Network Tech	0.000	16.130	17.217	11.095	9.987	10.243	10.005	10.193	Continuing	TBD		

Note: In FY 2007, Project 6266SP, Space Optical Network Technology, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 5082, Optical Networking Technology, in order to more effectively manage and provide oversight of the efforts.

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

This program develops technology for Air Force Command, Control, and Communications (C3). Advances in C3 are required to increase warfighter readiness and effectiveness by providing the right information, at the right time, in the right format, anytime, anywhere in the world. The program has four projects. The Communication Technology project develops assured and secure communications technology, and the capability to attack and exploit adversarial information and information Systems. The Information Technology project develops improved and automated capabilities to generate, process, fuse, exploit, interpret, and disseminate timely and accurate information. The Command and Control Technology project investigates and develops planning, assessment, and knowledge base technologies to allow the warfighter to plan, assess, execute, monitor, and re-plan on the complex, compressed time scales required for tomorrow's conflicts. The Space Optical Networking Technology project develops the technology base for the next generation of ultra-wide- bandwidth, multi-channeled, air and space-based communications networks on and between platforms. Note: In FY 2007, Congress added \$2.5 million for Adaptive Optics for Lasercom System, \$1.0 million for Advanced Collaboration Platform for Net Centric Command and Control (C2), \$1.5 million for MASINT Visualization Tools, \$1.1 million for Massively Parallel Optical Interconnects, \$2.2 million for Space Qualified Command Data Link, and \$1.6 million for Digital Free Space Optical Laser Transmitter Modems. This program is Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

R-1 Line Item No. 14	
Page-1 of 34	Exhibit R-2 (PE 0602702F)
313	

Exhibit R-2, RDT&E Buc	Iget Item Justification		DATE February 2007			
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602702F Command Cont					
(U) <u>B. Program Change Summary (\$ in Millions)</u>						
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) Previous President's Budget	96.714	119.267	118.562	116.126		
U) Current PBR/President's Budget	95.676	128.680	116.705	105.496		
U) Total Adjustments	-1.038					
U) Congressional Program Reductions						
Congressional Rescissions	-0.003	-0.487				
Congressional Increases		4.100				
Reprogrammings	-0.409	5.800				
SBIR/STTR Transfer	-0.626					
U) <u>Significant Program Changes:</u> Not Applicable.						
C. Performance Metrics						
(U) Under Development.						
	R-1 Line Item No. 14					
	Page-2 of 34		Exhibit R-2	2 (PE 0602702F		

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on				DATE	February 2	2007
	GET ACTIVITY Applied Research				06027	IBER AND TITL 02F Comma nunications		and			R AND TITLE	chnology
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012		FY 2013	Cost to	Total
451		Actual 22.087	Estimate 20.272	Estimate	Estimate 27.126	Estimate	Estimate	Estimat		Estimate	Complete	
451	9 Communications Technology Quantity of RDT&E Articles	23.987	29.273 0	27.458	27.126	35.448	24.788	29.3	0	31.385 0	Continuing	TBD
(U)	A. Mission Description and Budget			0	0	0	0		0	0		
	The Air Force requires technologies the communication and networking techno- reconnaissance and exploitation. A ra- communications media. This project p probability of intercept techniques; lig processors and devices, advanced network enabling communication signal processors	ologies will pr pidly deployed provides the tea thtweight, phas work protocols	ovide capabili d force require chnologies for sed array anter and services,	ties for en rou s assured con : multi-level, s nnas; and mod	ite and deploy nectivity with secure, seamle lular, program	ed distributed reliable, respo ess networks; a mable, low-co	collaborative onsive, afforda advanced com ost software ra	command, able inform munication dios. It inc	contro nation e ns proc ludes t	ol, surveilla exchange v essors; ant echnologie	nce, ia all available i-jam and low s for advance	
(U) (U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop assured worldwide command, control, surveil Force.	and survivable	e information		0 0	U	<u>FY 20</u> 9.7		<u>FY 20</u> 12.0		<u>FY 2008</u> 9.749	<u>FY 2009</u> 9.073
(U) (U)	In FY 2006: Completed development globally distributed information syste networking algorithms that enable wid services, independent of the underlyin self-organizing, self-healing, autonom technologies for real-time network res Developed communications/resource technologies enabling the dynamic int more effective moving target exploita (CBDN) technologies for intelligent n In FY 2007: Complete development of networking. Continue development of network response to changes in INFO communications/resource network may the dynamic integration of communic target exploitation and fusion. Contin	ms (e.g., JBI). de area dynam ag physical infraous networkin sponse to chan network mana tegration of co tion and fusion network delivers of capabilities of policy-based CON levels. Can agement sch ations and sen	Completed d ic creation of rastructure dev ag. Develope ges in informa agement scher mmunications h. Developed ry and manage for self-organ network man Continue deve emas and sens sor management	evelopment of advanced info vices. Develo d policy-based tion condition nas and sensor and sensor m content-based ement of end u izing, self-heat agement techn lopment and t for exploitation	f programmab prmation delive ped capabilitie d network mar n (INFOCON) r exploitation nanagement fu d delivery network user information ling, autonomic nologies for re- test of n technologies	le ery es for hagement levels. nctions for working on. ous al-time s enabling ive moving						
Pro	ject 4519				Line Item No. 1- Page-3 of 34	4					Exhibit R-2a (Pl	E 0602702F)
					315							

	Exhibit R-2a, RDT&E Pr	oject Justification		DAT	<sup>∈</sup> February	2007	
	DGET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER A		MBER AND TITLE	AND TITLE cations Technology	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>	<u>FY 2006</u>	<u>FY</u>	2007	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	network response to changes in INFOCON levels. Continue developm synergistic with the Joint Tactical Radio System Wideband Networking Layer, and apply to extremely dynamic airborne nets. Continue design network modeling and simulation technology. Initiate design and deve technology that senses operating environment, learns application requir network protocols. Initiate design and development of network operation provide policy-based, mission-based, cross-domain, heterogeneous net security, configuration and fault management in a net-centric environm intelligent network management agents designed to monitor the airborn of information from platform to platform through various interconnected links. Initiate development of a resilient and self-regenerating informa enterprise that dynamically recognizes, characterizes and understands r anomalies, aids in the creation of synthetically diverse, functionally eq- continuously monitors, reconfigures, and self optimizes the mission cri- attacks.	ted by tactical aircraft. nent technologies for real-time nent of airborne CBDN, g Waveform's Network Service a and development of airborne elopment of cognitive networking rements, and intelligently adapts ons and security capability to work quality of performance, nent. Develop and complete ne domain's handling of the flow ed communication nodes and tion Network Centric Warfare novel cyber attacks and service uivalent software, and itical enterprise to resist new ith the Joint Tactical Radio ad apply to extremely dynamic nodeling and simulation g technology that senses operating pools. Complete development of response to changes in tions and security capability to work quality of performance, ' small hand-held multi-data rate , lient and self-regenerating ponizes, characterizes and tion of synthetically diverse,					
	oject 4519	R-1 Line Item No. 14 Page-4 of 34				PE 0602702F)	

	Exhibit R-2a, RDT&E Project	DATE February 2007				
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Communications	d Control and	PROJECT NUMBER AND TITLE 4519 Communications Technol		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> mission critical enterprise to resist new attacks Initiate development of secure of the disclosure of sensitive information to untrustworthy users	lata sharing to prevent	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	are disclosure of sensitive information to unit astworthy asers					
(U)	MAJOR THRUST: Develop improved, higher bandwidth communications and technologies to provide secure, adaptive, covert, anti-jam, and assured global ba highly mobile aerospace forces, while reducing the equipment footprint.		4.484	4.705	4.359	3.731
(U) (U)	In FY 2006: Developed information assurance technologies that improve the re- Information Grid in both wireline and wireless networks for air, space, ground, environments to preclude information systems attacks such as distributed denial degradation of device quality. Developed higher performance, adaptively comb (space, time, frequency, coding, polarization) transmission techniques that enabs information transmission and exploitation capabilities over wireless channels w and control, and intelligence, surveillance, and reconnaissance missions, and the munitions. Completed development of higher performance video compression a techniques that enable critical objectives for high bandwidth information transm capabilities over wireless channels. Designed and developed a multi-mode, mu sense-and-adapt air-mobile communications capability to dynamically alter com- support, under fast-changing environments, higher-throughput, anti-jam, low pr and/or robust [assured] voice, data, and video communications. Performed such development within the framework of the Joint Tactical Radio System or compa- radios. Explored/exploited feasible applications of quantum key distribution an ultra-secure communications for wireline and wireless networks. In FY 2007: Complete first phase development of information assurance technor robustness of the Global Information Grid in both wireline and wireless networf and joint/coalition environments to preclude information systems attacks. Dem higher performance, adaptively combined multi-dimensional (space, time, frequ polarization) transmission techniques that enable high bandwidth information tr exploitation capabilities amongst airborne command and control, and intelligence reconnaissance platforms and various weapon delivery systems with their smart demonstrate a multi-mode, multi-function, sense-and-adapt air-mobile commun dynamically alter communications methods under fast-changing environment w	and joint/coalition of service and bined multi-dimensional le high bandwidth hich support command e use of intelligent and modulation hission and exploitation lti-function, munications methods to obability of intercept, n design and atible software defined d cryptography to effect blogies that improve the ks for air, space, ground, onstrate promising tency, coding, ansmission and ce, surveillance, and ications capability to				

	Exhibit R-2a, RDT&E Proj	ject Justification		DATE	DATE February 2007		
	et activity plied Research	PE NUMBER AND TITLE 0602702F Command Communications	0602702F Command Control and			chnology	
tl q	<b>3. Accomplishments/Planned Program (\$ in Millions)</b> he Joint Tactical Radio System or compatible software defined radios. E puantum key distribution and cryptography technologies to effect ultra-se and wireless networks. Perform transition planning.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U) I</li> <li>f</li> <li>ti</li> <li>s</li> <li>u</li> <li>ti</li> <li>d</li> <li>((</li> <li>v</li> <li>p</li> <li>d</li> <li>d</li> <li>d</li> <li>I</li> <li>n</li> <li>n</li> <li>(U) I</li> <li>e</li> <li>d</li> <li>((</li> </ul>	n FY 2008: Complete demonstration of adaptively combined multi-dime requency, coding, polarization) transmission techniques that enable high ransmission and exploitation capabilities. Complete demonstration of mu- tense-and-adapt air-mobile communications capability to dynamically alt inder fast-changing environment. Continue development of quantum key echnologies to effect ultra-secure communications for wired and wireless lemonstration of assure access, anti jam communications capability that of space, time, frequency, coding, polarization) transmission techniques, mu- vavelength, multi path techniques and spectrum sense and adapt techniques provide assured access (anti-jam) covert high capacity spectrum dominan lenying the adversary the same. Initiate development of scaleable video dynamically trade-off bandwidth and quality based upon the priority of th nitiate the development of advanced, automated, network and bandwidth nove, manage, and process information in real-time for the warfighter. In FY 2009: Complete development of quantum key distribution and cry effect ultra-secure communications for wired and wireless networks. Cor lemonstration of assure access, anti jam communications capability that of space, time, frequency, coding, polarization) transmission techniques, mu- nulti-wavelength, multi-path techniques, and spectrum sense and adapt techniques.	bandwidth information alti-mode, multi-function, ther communications methods of distribution and cryptography is networks. Initiate design and combines multi-dimensional ulti frequency, multi ues. Initiate investigation to the for global networking while compression schemes which the required information. In management technologies to ptography technologies to ntinue design and combines multi-dimensional ulti-frequency,					
	levelopment of advanced, automated, network and bandwidth manageme nanage, and process information in real-time for the warfighter.	ent technologies to move,					
(U) N in	MAJOR THRUST: Develop critical information transmission technologi ntegration of aerospace weapon systems' C2, intelligence, surveillance, a lata/information.		1.796	2.130	1.500	1.000	
r	In FY 2006: Explored techniques for tunable, high power radio frequency adio frequency component equipment size, weight, and signal losses. De exploratory radio frequency and optical information transfer technologies	eveloped, tested, and assessed					

BUDGET ACTIVITY       PE NUMBER AND TITLE       PROJECT NUMBER AND TITLE         02 Applied Research       0602702F Command Control and Communications       4519 Communications Tec         (U)       B. Accomplishments/Planned Program (\$ in Millions)       FY 2006       FY 2007       FY 2008         (U)       In FY 2007: Continue to explore multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses. Continue development, test, and assessment of exploratory radio frequency and optical information transfer technologies.       FY 2008: Complete development, test, and assessment of exploratory radio frequency and optical information transfer technologies. Continue to explore multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses applicable to battlefield network operations.       FY 2008	: <b>hnology</b> <u>FY 2009</u>
<ul> <li>(U) In FY 2007: Continue to explore multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses. Continue development, test, and assessment of exploratory radio frequency and optical information transfer technologies.</li> <li>(U) In FY 2008: Complete development, test, and assessment of exploratory radio frequency and optical information transfer technologies. Continue to explore multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses applicable to battlefield network operations.</li> </ul>	<u>FY 2009</u>
information transfer technologies. Continue to explore multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses applicable to battlefield network operations.	
(U) In FY 2009: Continue to explore multiple technologies/techniques for tunable, high power radio frequency filtering to reduce overall radio frequency component equipment size, weight, and signal losses applicable to battlefield network operations.	
<ul> <li>(U)</li> <li>(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop cyber operations technologies for enabling 7.944 7.866 11.850 worldwide command, control, communications and intelligence. This effort includes Congressional Add funding of \$1.0 million in FY 2006. Note: Increase in funding in FY 2008 and FY 2009 is due to emphasis on offensive cyber operations.</li> </ul>	13.322
(U) In FY 2006: Developed intrusion detection techniques for wireless networks. Developed automated capabilities for damage assessment and recovery. Developed techniques for defining defensive courses-of-action to counter adversary information warfare attacks. Developed defensive techniques for wireless, mobile and embedded systems. Developed detection and eradication techniques for malicious code. Developed of active response and computer network attack (CNA) technologies. Developed advanced correlation fusion techniques for defensive course of action analysis. Initiated work addressing self-healing systems. Conducted Congressionally directed efforts for Cyber Situational Awareness.	
<ul> <li>(U) In FY 2007: Complete development of intrusion detection techniques for wireless networks. Continue to develop automated capabilities for damage assessment and recovery. Continue to develop techniques for defining defensive courses-of-action to counter adversary information warfare attacks. Continue to develop defensive techniques for wireless, mobile and embedded systems. Continue to develop detection and eradication techniques for malicious code. Continue development of active response and CNA technologies. Continue development of advanced correlation fusion techniques for defensive course of action analysis. Continue efforts in self-healing systems.</li> </ul>	
R-1 Line Item No. 14Project 4519Page-7 of 34Exhibit R-2a (Pl	<u>= 0602702F)</u>

TACTIVITY Dlied Research <u>Accomplishments/Planned Program (\$ in Millions)</u> 1 FY 2008: Complete development of techniques for defining rapid defensive cour	PE NUMBER AND TITLE 0602702F Command Control and Communications FY 2006		February IBER AND TITLE unications Te	
FY 2008: Complete development of techniques for defining rapid defensive cour	FY 2006			
		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
gainst a variety of cyber threats with the end-goal of improving the overall defenses etwork. Initiate development of access techniques allowing "cyber paths" to protect formation systems through a multiplicity of attack vectors. Initiate development of ersistence technologies enabling continued operation within the adversary informat rograms to provide the capability to exfiltrate any and all types of information from formation systems enabling cyber intelligence gathering to achieve cyber awarenes inderstanding. Initiate technology programs to deliver D5 (deny, degrade, destroy, o ecceive) effects to the adversary information systems enabling integrated and synchra aditional kinetic operations.	hniques for miques for or defensive course eend Quality of enterprise during the unique aspects rking components) s of the airborne eted adversary f stealth and ion network. Initiate a compromised ss and disrupt, and ronized cyber and			
wher awareness and understanding. Continue to develop defensive techniques for we mbedded systems. Continue assured end-to-end Quality of Service (QoS) and Qual QoA) integration to the information system enterprise dueing malicious and non-ma- netitiate work in autonomic defensive response to rapidly recover from adversary cybe evelopment of information system access methods. Initiate efforts to propagate three tworks. Continue cyber intelligence gathering efforts to achieve cyber situational a	vireless, mobile and lity of Assurance alicious faults. er attacks. Continue ough adversary awareness and			
		2.500	0.000	0.000
			Evhibit P. 20 (	
	an IP-based airborne network (e.g., aircraft communications, antennas, and netwo gainst a variety of cyber threats with the end-goal of improving the overall defenses twork. Initiate development of access techniques allowing "cyber paths" to protect formation systems through a multiplicity of attack vectors. Initiate development of ersistence technologies enabling continued operation within the adversary information formation systems enabling cyber intelligence gathering to achieve cyber awarenes inderstanding. Initiate technology programs to deliver D5 (deny, degrade, destroy, o exceive) effects to the adversary information systems enabling integrated and synchr aditional kinetic operations. FY 2009: Initiate work in Cyber Command and Control for defensive cyber oper- tyber awareness and understanding. Continue to develop defensive techniques for w nbedded systems. Continue assured end-to-end Quality of Service (QoS) and Qual QoA) integration to the information system enterprise dueing malicious and non-ma- itiate work in autonomic defensive response to rapidly recover from adversary cybe welopment of information system access methods. Initiate efforts to propagate thr tworks. Continue cyber and traditional kinetic weapon integration technolog itiate efforts for cyber delivery to influence operations effects. ONGRESSIONAL ADD: Adaptive Optics Lasercom System FY2006: Not Applicable FY2007: Develop and demonstrate reliable bi-directional ground and/or airborne ommunications link that automatically acquires and maintains itself in a seamless on R-1 Line I Page	an IP-based airborne network (e.g., aircraft communications, antennas, and networking components) ainst a variety of cyber threats with the end-goal of improving the overall defenses of the airborne twork. Initiate development of access techniques allowing "cyber paths" to protected adversary formation systems through a multiplicity of attack vectors. Initiate development of stealth and resistence technologies enabling continued operation within the adversary information network. Initiate ograms to provide the capability to exfiltrate any and all types of information from compromised formation systems enabling cyber intelligence gathering to achieve cyber awareness and uderstanding. Initiate technology programs to deliver D5 (deny, degrade, destroy, disrupt, and secieve) effects to the adversary information systems enabling integrated and synchronized cyber and additional kinetic operations. FY 2009: Initiate work in Cyber Command and Control for defensive cyber operations to achieve ober awareness and understanding. Continue to develop defensive techniques for wireless, mobile and needded systems. Continue assured end-to-end Quality of Service (QoS) and Quality of Assurance (boA) integration to the information system enterprise dueing malicious and non-malicious faults. itiate work in autonomic defensive response to rapidly recover from adversary cyber attacks. Continue evelopment of information system access methods. Initiate efforts to propagate through adversary etworks. Continue cyber and traditional kinetic weapon integration technology development and derstanding. Continue cyber and traditional kinetic weapon integration technology development and derstanding. Continue cyber and traditional kinetic weapon integration technology development and distate efforts for cyber delivery to influence operations effects. ONORCRESSIONAL ADD: Adaptive Optics Lasercom System FY2006: Not Applicable FY2007: Develop and demonstrate reliable bi-directional ground and/or airborne lasercom mmunications link that automatica	ian IP-based airborne network (e.g., aircraft communications, antennas, and networking components) ain IA variety of cyber threats with the end-goal of improving the overall defenses of the airborne twork. Initiate development of access techniques allowing "cyber paths" to protected adversary formation systems through a multiplicity of attack vectors. Initiate development of stealth and rrsistence technologies enabling continued operation within the adversary information network. Initiate ograms to provide the capability to exfiltrate any and all types of information from compromised formation systems enabling cyber intelligence gathering to achieve cyber awareness and diderstanding. Initiate technology programs to deliver D5 (deny, degrade, destroy, disrupt, and ceeive) effects to the adversary information systems enabling integrated and synchronized cyber and additional kinetic operations. FY 2009: Initiate work in Cyber Command and Control for defensive cyber operations to achieve ber awareness and understanding. Continue to develop defensive techniques for wireless, mobile and nbedded systems. Continue assured end-to-end Quality of Service (QoS) and Quality of Assurance QoA) integration to the information system enterprise dueing malicious and non-malicious faults. Itate work in autonomic defensive response to rapidly recover from adversary cyber attacks. Continue evelopment of information system sense florts to propagate through adversary etworks. Continue cyber and traditional kinetic weapon integration technology development and itate efforts for cyber delivery to influence operations effects. ONGRESSIONAL ADD: Adaptive Optics Lasercom System FY2000? Not Applicable FY2007: Develop and demonstrate reliable bi-directional ground and/or airborne lasercom mmunications link that automatically acquires and maintains itself in a seamless operation. R-1 Line term No. 14 Page-8 of 34	an IP-based airborne network (e.g., aircraft communications, antennas, and networking components) ain ta variety of cyber threats with the end-goal of improving the overall defenses of the airborne twork. Initiate development of access techniques allowing "cyber paths" to protected adversary formation systems through a multiplicity of attack vectors. Initiate development of stealth and resistence technologies enabling continued operation within the adversary information network. Initiate ograms to provide the capability to exfiltrate any and all types of information from compromised formation systems enabling cyber intelligence gathering to achieve cyber awareness and derstanding. Initiate technology programs to deliver D5 (deny, degrade, destroy, disrupt, and cecive) effects to the adversary information systems enabling integrated and synchronized cyber and aditional kinetic operations. FY 2009: Initiate work in Cyber Command and Control for defensive cyber operations to achieve ber awareness and understanding. Continue to develop defensive techniques for wireless, mobile and nebedded systems. Continue assured end-to-end Quality of Service (QoS) and Quality of Assurance DoA) integration to the information system enterprise dueing malicious and non-malicious faults. It at work in autonomic defensive response to rapidly recover from adversary cyber attacks. Continue vevelopment of information system access methods. Initiate efforts to propagate through adversary tworks. Continue cyber and traditional kinetic weapon integration technology development and titate efforts for cyber delivery to influence operations effects. ONGRESSIONAL ADD: Adaptive Optics Lasercom System FY2007: Develop and demonstrate reliable bi-directional ground and/or airborne lasercom mmunications link that automatically acquires and maintains itself in a seamless operation. <b>R</b> -1 Line term No. 14 <b>Page-8</b> 034 <b>Exhibit R-26</b> (F

	Exhibit	R-2a, RD	T&E Projec	t Justif					DATE		2007
BUDGET ACTIVITY 02 Applied Research							February 2007 CT NUMBER AND TITLE Communications Technolog				
<ul> <li>(U) <u>B. Accomplishments/Planned</u></li> <li>(U) In FY2008: Not Applicable</li> <li>(U) In FY2009: Not Applicable</li> </ul>	Program (\$ in	<u>Millions)</u>					<u>FY 20</u>	<u>)06</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) Total Cost							23.9	987	29.273	27.458	27.126
(U) <u>C. Other Program Funding Su</u>	<u>ımmary (\$ in N</u>	<u>fillions)</u>									
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0603789F, C3I Advanced Development.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	<u>FY 20(</u> <u>Estim</u>		Y 2010 Estimate	FY 2011 Estimate	FY 2012 Estimat			
Project 4519				R-1 Line Ite Page-9 32 <b>INCLAS</b>	of 34 <b>1</b>					Exhibit R-2a (	PE 0602702F

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
					06027	02F Comma					ogy
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	· · ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
BUDGET ACTIVITY         PE NUMBER AND TITLE         PROJECT NUMBER AND           02 Applied Research         Provide the second control and context and control and control and control and contro	Continuing	TBD									
				0	0	0	0		) 0		
	The Air Force requires technologies the accurate information. This project im the timeliness and precision needed to government agencies, and open source information enterprise. Knowledge, in technologies required to achieve this co partners. This project develops high-pre- enable global information dominance	hat improve an proves global accomplish th e information. nformation, an capability are o payoff embedo and air and sp	ad automate th awareness at a neir missions. The informat ad data are all a leveloped und led information ace superiority	Il levels, enab Global aware ion is fused to archived in th er this project n systems tecl	bling warfighte eness is achiev o support the d e global inform t in an affordat hnologies for t	ers to understa ed by exploitin ynamic planni nation base fo ole manner and he next genera	nd relevant m ng information ng, assessmen r continued us d include appr ation of distrib	ilitary situat n provided b nt and execu se and histor ropriate acce puted inform	ions on a consis y the Air Force tion cycles via ical analysis. T ss mechanisms ation integratio	stent basis with , other the global The information for our coalition n architectures	1 ON
ì í	MAJOR THRUST: Develop innovat	ive multi-sens		e fusion tech	nologies in a fi	ully				<u>FY 2008</u> 7.062	<u>FY 2009</u> 6.386
	In FY 2006: Developed and evaluated analyzed vehicle motion models for v vehicle with a future state. Enhanced continuous tracking of military signif data mining techniques for improved higher levels of fusion in analyzing si In FY 2007: Evaluate fusion manage techniques. Continue the process of p Increase probabilistic confidence thro situational assessment and process ref advanced reasoning fusion engines to	I fusion techni ariable state n multi-source icant threats in fusion perform tuational asses ment and adva probabilistic id ough the inclus finement area. adapt to chan agement techn g of military si ion techniques	nultiple algorit fusion techniq in the battlespace nance. Develor soment and pro- soment and pro- nice the state-or entification the ion of higher- Develop tech ging threat con- niques that opt gnificant threa- to the warfight	hm to associa ues for probal ce. Evaluated ped new mea ocess refineme of-the-art in tr ough the use level fusion te niques to dyn aditions. Dev imize the fusi ts. Evaluate ater.	te the current i bilistic identifi evidence accru sures of perfor- ent. rack-to-track fu of multi-sourc echniques in th amically upda elop intelligen on process for network centr	location of cation and ual and rmance for usion e fusion. le te te te ce,					
	-			R-1	Line Item No. 1	4					
Proj	ect 4594				Page-10 of 34 322					Exhibit R-2a (P	E 0602702F)

	Exhibit R-2a, RDT&E Proj	DA.	DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4594 Information Technology		
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) techniques. Continue the process of probabilistic identification though th Continue to increase probabilistic confidence through the inclusion of hig the situational assessment and process refinement area. Continue to deve update advanced reasoning fusion engines to adapt to changing threat con intelligence, surveillance, and reconnaissance management techniques tha for identification and continuous tracking of military significant threats. The approaches to provide distributed fusion techniques to the warfighter. Dee that combine traditional kinematic associations with multi-INT reasoning and track life times of ground moving targets; taking into account the lime target environments and large sensor data inaccuracies. Develop a set of automatically develop, reason, dynamically update various sub-sets of the preparation of the battlespace products (e.g., named areas, target areas, Cl lines of communication). Initiate development of fused air, ground, and se machine-to-machine automatic fusion and dynamic re-tasking processes to centric operational picture. Processes to be examined include machine-to- fusion, long term automated tracking and ID of nominated targets, and au recognition. Initiate investigation of Fusion of CybINT (Cyber Intelligen In FY 2009: Evaluate fusion management and advance the state-of-the-a techniques. Complete the process of probabilistic identification though th Continue to increase probabilistic confidence through the inclusion of hig the situational assessment and process refinement area. Complete the dev dynamically update advanced reasoning fusion engines to adapt to changi Complete the development and assessment of intelligence, surveillance, a management techniques that optimize the fusion process for identification military significant threats. Complete the development and assessment of provide distributed fusion techniques to the warfighter. Continue the dev algorithms that combine traditional kinematic associations with multi	<u>FY 2006</u> e use of multi-source fusion. gher-level fusion techniques in elop techniques to dynamically nditions. Continue to develop at optimize the fusion process Evaluate network centric evelop new track algorithms (to improve the identification itations of gap times, dense algorithms that can e existing intelligence OA, units, infrastructure areas, space information through resulting in a single network o-machine automated multi-INT ntomated/adaptive pattern nee) with traditional INTs. rt in track-to-track fusion he use of multi-source fusion. gher-level fusion techniques in velopment of techniques to ing threat conditions. and reconnaissance n and continuous tracking of f network centric approaches to relopment of new track T reasoning to improve the ccount the limitations of gap nplete the development of a set e various sub-sets of the existing	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
	oject 4594	R-1 Line Item No. 14 Page-11 of 34		Exhibit R-2a (F	

	Exhibit R-2a, RDT&E Proje		DATE February 2007					
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Communications	d Control and	PROJECT NUMBER AND TITLE 4594 Information Technology				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> infrastructure areas, lines of communication). Continue development of fus information through machine-to-machine automatic fusion and dynamic re- a single network centric operational picture. Processes to be examined inclu automated multi-INT fusion, long term automated tracking and ID of nomir automated/adaptive pattern recognition. Continue investigation of Fusion of INTs.	tasking processes resulting in ide machine-to-machine nated targets, and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
U) U)	MAJOR THRUST: Develop higher-level fusion and the enabling informati technologies to achieve situational awareness and understanding at all comr planning, assessment and execution processes.	•	5.503	6.745	7.319	8.668		
U)	In FY 2006: Completed development of intermediate information extraction analysis time for decision-making and enabling the ability to populate know Completed development of techniques addressing key entity extraction tech accuracy of Air Force and joint systems that exploit information from unstru- analysis. Developed interactive contextual reasoning with inference technic repositories, and content-based extraction to support identification of potent Enhanced web-based search techniques, data filtering techniques, and inform to take advantage of the explosion of available open source data on the Web situational understanding. Developed inferencing techniques for reasoning predict enemy intent and threat possibility.	vledge base systems. nology gaps, to improve the uctured text for situation ques for self-organizing data tial events in the world. mation aggregation methods o required for rapid about the situation and						
U)	In FY 2007: Enhance techniques for interactive contextual reasoning with i self-organizing data repositories and content-based extraction to support ide events in the world. Continue enhancement of web-based search techniques and information aggregation methods to take advantage of the explosion of on the Web required for rapid situational understanding. Continue developit for reasoning about the situation and for predicting enemy intent and threat	entification of potential s, data filtering techniques, available open source data ing inferencing techniques						
U)	In FY 2008: Complete enhancement of techniques for interactive contextua techniques for self-organizing data repositories and content-based extraction potential events in the world. Continue enhancement of web-based search t techniques, and information aggregation methods to take advantage of the e source data on the Web required for rapid situational awareness and underst	al reasoning with inference n to support identification of echniques, data filtering explosion of available open						
Dro	bject 4594	R-1 Line Item No. 14 Page-12 of 34			Exhibit R-2a (I			

	Exhibit R-2a, RDI & Project Justification					DATE February 2007		
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Communications	Control and		IBER AND TITLE			
	information aggregation methods to take advantage of the explosion of avail Web required for rapid situational awareness and understanding. Continue of techniques for reasoning about the situation and for predicting enemy intent Continue development of multi-source and automated recognition technique current situations. Continue development of technology demonstration plan awareness and understanding using an autonomous set of cooperative agents defend mission critical AF assets. Initiate development of technology demon defense on wired networks to perform an adaptive response to multiple, coor Continue research to achieve the capability to analyze multiple courses of ac cascading effects in near real-time. The capability will be able to mix kinetic continuously forecast the direct and indirect effects of each COA, and play O identify key plan dependencies, decision points, and the foreclosure of option forecast actionable futures to support a decision maker's ability to appraise a	nt capability with the se infospheres by 100X. to support analysis of current r situational awareness and control to defend mission ation plans for active ks to perform an adaptive ecast actionable futures to e of action for Rapid, e multiple courses of action le to mix kinetic and each COA, and play COAs foreclosure of options. Filtering techniques, and lable open source data on the developing inferencing and threat possibility. es to support analysis of s for cyber situational s under positive control to nstration plans for active ISR ordinated, sustained attacks. etton (COA) having e and non-kinetic options, COAs forward in time to ns. Continue research to	<u>FY 2006</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	course of action for Rapid, Decide, Act and Adapt. MAJOR THRUST: Develop automatic and dynamically reconfigurable, aff	ordable, scalable, distributed	4.041	4.770	6.273	7.068		
Pro	ject 4594	R-1 Line Item No. 14 Page-13 of 34			Exhibit R-2a (F			

	Exhibit R-2a, RDT&E Project Jus	tification	C	February 2007	,	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control a Communications		DJECT NUMBER AND TITLE <b>34 Information Technology</b>		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> petaflop processing technologies for real-time C2 global information systems.	<u>FY 200</u>	<u></u>	<u>FY 2008</u> <u>FY 2</u>	<u>2009</u>	
(U)		nant battlaspace				
(0)	awareness. Completed study results of next generation information technologies fo	-				
	Evaluated architectural features for cognitive information processing. Initiated algo	-				
	for next generation information technologies for C2 systems. Initiated architectural	-				
	cognitive information processing. Developed and characterized high performance of	-				
	quantum computing applications.					
(U)	In FY 2007: Complete evaluation of architectural features for cognitive information	n processing.				
Ì,	Continue algorithm development for next generation information technologies for C					
	architectural development for cognitive information processing. Continue development	-				
	characterization of high performance computers for quantum computing application	s. Initiate				
	development and characterization of the next generation of high performance comp	uters.				
(U)	In FY 2008: Initiate implementation of architectural features for cognitive information					
	Continue algorithm development for next generation information technologies for C					
	development and characterization of high performance computers for quantum com					
	Continue development and characterization of the next generation of high performa	-				
	Develop a prototype chip that contains a hybrid architecture design; which will prov					
	capability for large scale cognitive architecture evaluations. Initiate the development					
(U)	techniques, standards and technologies required to build highly complex software-in In FY 2009: Continue implementation of architectural features for cognitive inform	-				
(0)	Complete algorithm development for next generation information technologies for (					
	Complete architectural development for cognitive information processing. Complet					
	characterization of high performance computers for quantum computing application	-				
	development and characterization of the next generation of high performance comp					
	development of a prototype chip that contains a hybrid architecture design; which w	-				
	emulation capability for large scale cognitive architecture evaluations. Continue the	-				
	tools, techniques, standards and technologies required to build highly complex softw	vare-intensive				
	systems. Initiate development of high capacity processing on demand which will re-	duce the ever				
	increasing amounts of raw data to actionable information. Provide hardware and system	stem/support				
	software that enables complex software to be readily composed.					
(U)						
	R-1 Line	Item No. 14				
Pro		-14 of 34		Exhibit R-2a (PE 0602	2702F)	
		326				

Exhibit R-2a, RDT&E Project Jus	stification		DATI	February	2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITL 0602702F Comma Communications			MBER AND TITLE	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) MAJOR THRUST: Develop modeling and simulation technologies for the next ge assessment, and execution environments.	neration of planning,	2.426	2.776	2.793	2.579
<ul> <li>(U) In FY 2006: Developed advanced modeling and simulation technologies to suppor planning execution and assessment environments. Developed adversarial behavior modeling techniques for dynamic course of action assessment and prediction. Initi techniques for integrated interaction and assessment of friendly versus enemy cour Developed simulation techniques for dynamic situation assessment and prediction.</li> </ul>	models and ated investigation of				
<ul> <li>(U) In FY 2007: Demonstrate advanced modeling and simulation technologies to supp planning execution and assessment environments. Demonstrate adversarial behavi modeling techniques for course of action assessment and prediction. Conduct cond integrated interaction and assessment of friendly versus enemy courses of action. I prototypical dynamic situation assessment and prediction system. Investigate adva provide approaches for a modeling toolset that enables the warfighter to build com</li> </ul>	or models and ept demonstrations of Demonstrate a need concepts to				
(U) In FY 2008: Complete demonstrations of advanced modeling and simulation techn next generation planning, assessment and execution environments. Continue to demonstrations of action (COA) assessment Continue to conduct concept demonstrations of integrated interaction and assessment adversary courses of action. Continue to demonstrate a prototypical dynamic situal prediction system. Continue to investigate advanced concepts to provide approach toolset that enables the warfighter to build composable simulations. Initiate investigate and/or anticipated threat(s).	ologies to support nonstrate adversarial and prediction. nt of friendly versus ion assessment and es for a modeling gation of ability to				
<ul> <li>(U) In FY 2009: Complete demonstrations of adversarial behavior models and modelin courses of action assessment and prediction. Continue to conduct concept demonstration and assessment of friendly versus adversary courses of action. Complete prototypical dynamic situation assessment and prediction system. Continue to invest concepts to provide approaches for a modeling toolset that enables the warfighter to simulations. Continue investigation of ability to forecast potential adversaries and indications of known evidence and projected known and/or anticipated threat(s).</li> </ul>	rations of integrated e demonstration of a stigate advanced b build composable				
(U)					
(U) MAJOR THRUST: Develop real-time embedded information system technologies	for complex,	1.978	2.210	2.700	1.962
Project 4594 Page	ltem No. 14 15 of 34 327			Exhibit R-2a (	PE 0602702F)

Exhibit R-2a, RDT&E Pro	DATI	DATE February 2007			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITL 4594 Information Techn			
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> time-critical, embedded systems to enable affordable design and develo hardware and software, innovatively incorporate new capabilities, react and changing environments, verify, validate, and assure functionality ar insertion to support real-time, collaborative operations within a net-cent	ively adapt to multiple missions nd integrity, and facilitate rapid tric enterprise.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2006: Developed dynamically reconfigurable aerospace systems techniques to support image/video processing and data compression. D computing technologies to support enhanced interoperability and inform C2 platforms to support network centric operations, based on Real-Time computing. Developed processes, methods, and techniques to provide a and security of real-time embedded information systems. Developed al to support real-time, adaptive resource management of system resources	Developed adaptive embedded nation exchange between tactical e Java and reconfigurable assured performance, integrity, gorithms, methods, and processes				
<ul> <li>platforms. Developed multi-level secure middleware for real-time emb Developed methods of computation and computing processes using bio biologically-based computation for embedded systems application. Init power-aware, polymorphic aerospace systems for mission-aware comput</li> <li>(U) In FY 2007: Continue development of dynamically reconfigurable aero computing techniques to support image/video processing and data comp</li> </ul>	logically-inspired and tiated development of uting. ospace systems using adaptive pression. Complete program to				
<ul> <li>develop adaptive embedded computing technologies to support enhance information exchange between tactical C2 platforms to support network Real-Time Java and reconfigurable computing. Continue to develop pro- to provide assured performance, integrity, and security of real-time emb Continue to develop algorithms, methods, and processes to support real management of system resources across multiple tactical platforms. Co- secure middleware for real-time embedded system architectures. Continues</li> </ul>	c centric operations, based on ocesses, methods, and techniques bedded information systems. -time, adaptive resource ontinue to develop multi-level				
<ul> <li>computation and computing processes using biologically-inspired and b for embedded systems application. Continue development of power-aw systems for mission-aware computing.</li> <li>(U) In FY 2008: Continue development of dynamically reconfigurable aero computing techniques to support image/video processing and data comp</li> </ul>	biologically-based computation ware, polymorphic aerospace ospace systems using adaptive pression. Continue development				
of affordable, high assurance architecture components for real-time emb Multi-Level Security/Multiple Single Levels of Security (MLS/MSLS) Project 4594					

Exhibit R-2a, RDT&E Project Justification February 2007						
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Comman Communications		PROJECT NUM			
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> development of methods of computation and computing pro biologically-based computation for embedded systems appl power-aware, polymorphic aerospace systems for mission-a	ication. Initiate development of	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2009: Continue development of dynamically reconfic computing techniques to support image/video processing an of affordable, high assurance components for real-time emb Security/Multiple Single Levels of Security (MLS/MSLS) a of methods of computation and computing processes using computation for embedded systems application. Continue of aerospace systems for mission-aware computing.	gurable aerospace systems using adaptive and data compression. Continue development bedded systems supporting Multi-Level and mixed criticality. Continue development biologically-inspired and biologically-based					
(U) (I) MAJOD THENST/CONCRECCIONAL ADD: Develor 4		( ((1	0.424	C 007	5 029	
<ul> <li>(U) MAJOR THRUST/CONGRESSIONAL ADD: Develop di for electronic communications and special signals intelligen increase accuracy, correlation, and timeliness of the inform This effort includes Congressional Add funding of \$1.5 mi</li> <li>(U) In FY 2006: Developed tools to increase the production ca techniques in steganography, steganalysis, watermarking, a and speech information protection and authentication, intell</li> </ul>	nce, imagery, and measurement signatures to ation value to the decision maker. Note: llion in FY 2007. pability of the intelligence analyst. Develop nd digital data forensics for imagery, video,	6.661	9.434	6.007	5.028	
Developed tools to detect, track, and analyze document and steganography, steganalysis, and digital watermarking.						
(U) In FY 2007: Complete first phase development of techniqu watermarking, and digital data forensics for imagery, video authentication, and intelligence exploitation. Continue the toolsets for the processing, exploitation and dissemination of development of MASINT capability which integrates input the critical MASINT information. Conduct Congressionall tools.	, and speech information protection and development of the multi- intelligence of actionable intelligence, including the s from various sensors and visually display					
<ul> <li>(U) In FY 2008: Continue the development of the multi- intelli exploitation and dissemination of actionable intelligence. I exploitation algorithms to enhance detection (by 50%), ider reduction in analyst time) of difficult targets; taking into ac</li> </ul>	Develop more effective multi-sensor signature ntification (by 25%), and assessment (10X					
	R-1 Line Item No. 14					
Project 4594	Page-17 of 34 <b>329</b>			Exhibit R-2a (I	PE 0602702F)	

	Exhibit R-2a, RDT&E Project Justification					DATE	DATE February 2007				
BUDGET ACTIVITY 02 Applied Research				0602				PROJECT NUMB	ECT NUMBER AND TITLE		
(U)	<b>B. Accomplishments/Planned</b> (e.g., geo-physical, materials) th to automatically detect and iden personal communications system automatically detect speech priv	hat can be derive tify audio prote ns (PCS) with t	ed from multip ction and char he goal of pro	nelization effe viding analysts	cts in modern r	nodulated	<u>FY 2</u>	<u>006</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue the deve dissemination of actionable inter- signature exploitation algorithm assessment (10X reduction in an signature features (e.g., geo-phy Complete the development to an effects in modern modulated per- capability to automatically detec- development of methods and mo- self-regenerating code/data and will include the detection and pr self-optimization / diagnosis / re- data for trusted and optimized c	lligence. Comp s to enhance de halyst time) of d vical, materials atomatically det rsonal communi- ct speech privace echanisms to ac detection and en- revention of em- ecovery, and the	blete the develo tection (by 50 lifficult targets ) that can be do ect and identifications system y and identify hieve robust/taradication syst bedded malico	opment of more %), identifications is taking into accepted from mu- by audio protect ns with the goar methods and namper-proof sec- ems for polymous software (more sec-	e effective mul- on (by 25%), a ecount the comp litiple MASIN cion and channe al of providing means used. In lf-authenticatin orphic malware alware), system	ti-sensor nd plementary Γ sensors. elization analysts the itiate g, e. Research n					
(U)	Total Cost						26.	879	33.581	32.154	31.691
(U)	<u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> FY 2007 <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete	I otal Cost
` '	Related Activities: PE 0603789F, C3I Advanced Development.										-
	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

Exhibit R-	2a, RDT&E Project Justification		DATE February 2007
JDGET ACTIVITY 2 Applied Research			
J) <b><u>D. Acquisition Strategy</u></b> Not Applicable.			
	R-1 Line Item No. 14		
Project 4594	Page-19 of 34		Exhibit R-2a (PE 060270

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	GET ACTIVITY pplied Research			06027	IBER AND TITL 02F Comma nunications		and 5	ROJECT NUMBE 581 Comman schnology		rol (C2)	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5581	Command and Control (C2) Technology	44.810	49.696	39.876	35.584	49.132	45.263	42.076		Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	A. Mission Description and Budget The Air Force requires C2 technologic real-time, distributed battle management new structured and ad hoc processes i information interoperability, while real techniques knowledge bases, distribut technologies will vastly improve the r continuously track objects and events courses of action to counter their inter knowledge are needed by the Expedit C2 centers to respond to varying crisis technologies will ensure the delivery of	es that will pro- ent and control n response to n ducing the cost ed information nilitary decision will improve to ntions. Advan- ionary Aerospa- s levels, as req	vide the next . Technologic apidly changi of C2 system a systems, and on making pro he awareness ces in the deve ace Force. Ad uired, by a Ne	es in this proje ng warfare ch s and infrastru information r cess within C2 and understan elopment of ve vances in dist t-Centric Aere	ect must be cap allenges. Tech acture. Techno nanagement an 2 systems. Ad ading and pred ery large comp ributed intellig ospace Force.	pable of taking mologies being ology develop nd distribution wances in the iction of adves prehensive kno gent informati Advances in t	g advantage of g developed w ment in this p n services. Ad ability to rapio rsarial intentio owledge bases on systems wi	f future net-co vill increase c roject focuse lvances in pla dly detect, cla ons, allowing to rapidly fo ill allow auto	entric environn apability, qual s on planning a unning and asse assify, identify, the developme rmulate and cre matic rapid rec	nents includin ity, and and assessing essment , and ent of various eate new onfiguration of	-
	<b><u>B. Accomplishments/Planned Prog</u></b> MAJOR THRUST: Investigate and d			rapid develop	ment and appl	ication of	<u>FY 20</u> 6.8		<u>Y 2007</u> 7.730	<u>FY 2008</u> 6.499	<u>FY 2009</u> 5.501
(U) (U)	next generation knowledge bases for a In FY 2006: Demonstrated tools that classification of link patterns for disco technologies for the rapid development aerospace C2 systems. Initiated development tasks in the real world requiring intell self-aware, learning agents. In FY 2007: Complete development generation knowledge bases for aeros and tools to enable effective, practical	will automate overing releva nt and applicat lopment of fou scale and comp ligence. Initiat of technologie space C2 system	the intelligent int linkages bet ion of next ge indations, tech plexity require ed developme s for the rapid ms. Continue	tween entities neration know mology, and t d for compute ent of cognitiv development to develop for	Developed vledge bases for ools to enable ers to perform e architectures and application undations, tech	or effective, complex s for on of next nnology,					
	computers to perform complex tasks is specialized cognitive architectures us			nts that can ge R-1	-	cused				Exhibit R-2a (P	PE 0602702F)
					332					- (-	- /

Exhibit R-2a, RDT&E Project Justification						2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Communications	Control and		DJECT NUMBER AND TITLE		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> knowledge bases for automated intelligent extraction, correlation, and classific	cation of link patterns for	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	discovering relevant linkages between entities. In FY 2008: Continue to develop foundations, technology, and tools to enabl automated reasoning of the scale and complexity required for computers to per real-world requiring intelligence. Continue to investigate and develop special architectures using self-aware, learning agents that can generate well-focused automated intelligent extraction, correlation, and classification of link pattern linkages between entities. Develop a prototype that will have the capability, g and Rules of Engagement, to apply context-aware access control to rapidly de initiate reprioritization as required using operational databases and an availab infrastructure. Initiate development of automated capture and self-organization globally distributed respositories. In FY 2009: Continue to develop foundations, technology, and tools to enabl	erform complex tasks in the lized cognitive knowledge bases for s for discovering relevant given commander's policies etect significant events and le information management on of knowledge in					
(U)	in FY 2009: Continue to develop foundations, technology, and tools to enable automated reasoning of the scale and complexity required for computers to per real-world requiring intelligence. Continue to investigate and develop special architectures using self-aware, learning agents that can generate well-focused automated intelligent extraction, correlation, and classification of link pattern linkages between entities. Continue development of automated capture and s knowledge in globally distributed respositories.	erform complex tasks in the lized cognitive knowledge bases for s for discovering relevant					
(U)	MAJOR THRUST: Investigate, analyze, and develop technologies for autom of distributed intelligent information systems to varying crisis levels faced by Aerospace Force.		12.293	13.622	10.241	9.320	
(U)	In FY 2006: Developed dynamic and adaptable interface technology that allo mission-tailored view of the configuration and status of the currently executin Developed advanced interactive displays suitable for deployment in harsh env applications and command centers. Developed advanced techniques and AO information visualization for use in conjunction with multiple, heterogeneous technologies to improve the fidelity, accuracy, and interconnection of comput prepare contingency plans and response strategies. Initiated development of to tool set that commanders can use to probe, study, analyze, visualize, reason, a	ng AOC C2 process. vironments with C2 C-based applications for data sets. Developed ter-based wargames used to technologies for a holistic					
1	R	-1 Line Item No. 14					

Exhibit R-2a, RDT&E Project Justification Feb						
	DGET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications			MBER AND TITLE nand and Control (C2) y	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>	<u>FY 2006</u>	5 <u>FY</u>	<u>2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	battlespace. In FY 2007: Continue to develop dynamic and adaptable interface techno to create a mission-tailored view of the configuration and status of the curr process. Continue to develop advanced interactive displays suitable for ra environments with C2 applications and command centers. Continue devel techniques and AOC-based applications for information visualization for u multiple, heterogeneous data sets. Continue to develop technologies to im and interconnection of computer-based wargames used to prepare conting strategies. Continue development of technologies for a holistic tool set tha probe, study, analyze, visualize, reason, and predict activities in the battles. In FY 2008: Complete the development of dynamic and adaptable interface commanders to create a mission-tailored view of the configuration and sta AOC C2 process. Continue to develop advanced interactive displays suita harsh environments with C2 applications for information visualization for u multiple, heterogeneous data sets. Continue to develop technologies to im and interconnection of computer-based wargames used to prepare continger strategies. Continue development of technologies for a holistic tool set that probe, study, analyze, visualize, reason, and predict activities in and aroun advanced mission planning process that will provide a self-healing, secure scheduling process that resembles an auction style planning capability. In capabilities to be more agile within a net centric enabled environment. De generation selection and coordination capabilities that account for uncertai erroneous information, and supports intuitive decision making process bet	rently executing AOC C2 apid deployment in harsh lopment of advanced use in conjunction with aprove the fidelity, accuracy, ency plans and response at commanders can use to space. ce technology that allows able for rapid deployment in e development of advanced use in conjunction with aprove the fidelity, accuracy, ency plans and response at commanders can use to ad the battlespace. Develop an e, rule-based automatic itiate development of evelop timely option inty and missing and				
(U)	collaborating on complex, dynamic problems exploiting the respective stree lots of data) and human (analytical reasoning). Develop dynamic workflo capabilities to manage the command and control constellation of resources In FY 2009: Continue to develop advanced interactive displays suitable for environments with C2 applications and command centers. Continue devel techniques and AOC-based applications for information visualization for u multiple, heterogeneous data sets. Continue to develop technologies to im	w and workload management s. or rapid deployment in harsh lopment of advanced use in conjunction with				
	oject 5581	R-1 Line Item No. 14 Page-22 of 34				PE 0602702F)

	Exhibit R-2a, RDT&E Project Justification February 2007						
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602702F Command Communications	Control and		NUMBER AND TITLE mmand and Control (C2) ogy		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> and interconnection of computer-based wargames used to prepare contingency pla strategies. Continue development of technologies for a holistic tool set that comm probe, study, analyze, visualize, reason, and predict activities in the battlespace. C of capabilities to be more agile within a net centric enabled environment. Continu timely option generation selection and coordination capabilities that account for ur and erroneous information, and supports intuitive decision making process betwee collaborating on complex, dynamic problems exploiting the respective strengths of lots of data) and human (analytical reasoning). Continue the development of dyna workload management capabilities to manage the command and control constellat	anders can use to Continue development e the development of neertainty and missing n man and machine f machines (process mic workflow and	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Investigate and develop technologies to securely share inform subscribe, and query with coalition partners as part of the overall Global Informati Sharing of information is in part a function of secure sharing, but is also a function	nation via publish, on Grid approach. n of the managing of	6.446	9.349	7.758	6.361	
(U) (U)	the information in assessing the trustworthiness of the information and its markup. In FY 2006: Completed investigation of technologies to dynamically filter and fus produce customized coalition information products. Developed technology approx assimilate appropriate coalition partners into appropriate COI Infospheres. Extend information sharing research and development to include collaborative monitoring multi-national enterprise resources such as firewalls/guards/routers, application set detection systems, etc. Investigated the ability to perform and enforce role-based a COI Infospheres. Focused research on multi-domain event correlation from a cent (e.g., guarding services enabled, multi-level security repository) in order to establi of resource status with the ability to centrally react to that status. Developed techn will ensure availability, integrity, and survivability of information within a coalitic environment. Initiated development of publish/subscribe technologies for applicat system for intelligent network management of user information. In FY 2007: Complete development of techniques and tools that will ensure availa survivability of information within a coalition net-centric environment. Complete technology approaches to rapidly assimilate appropriate coalition partners into app Infospheres. Complete investigation on performing and enforcing role-based acce COI Infospheres. Continue cross-domain information sharing research and develop	se information and aches to rapidly led cross-domain and management of rvers, intrusion access control to these tralized perspective sh a composite picture siques and tools that on net-centric tion to a CBDN ability, integrity, and development of propriate COI ss control to these					
		e Item No. 14			Exhibit R-2a (I		

<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>         collaborative monitoring and management of multi-national enterprise resources. Continue dev         of techniques and tools that will ensure availability, integrity, and survivability of information v         coalition net-centric environment. Investigate technologies, which can determine the pedigree (         information in a coalition environment and assess the trustworthiness of the marked up informat         shared throughout the coalition. Investigate and prototype the application of information fusior         information to a CBDN system for intelligent network management of user information.         (U) In FY 2008: Continue cross-domain information sharing research and development to include         collaborative monitoring and management of multi-national enterprise resources. Continue dev         of techniques and tools that will ensure availability, integrity, and survivability of information.     </li> <li>(U) In FY 2008: Continue cross-domain information sharing research and development to include         collaborative monitoring and management of multi-national enterprise resources. Continue dev         of techniques and tools that will ensure availability, integrity, and survivability of information of         audition net-centric environment. Continue to investigate and prototype the application of information discuss a multi-domain enterprise into fused events. Continue development of publish/subscribe         technologies for application to a content-based delivery networking (CBDN) system for intellig         network management of user information. Initiate development of technologies to systematical         integrate information sources across COI's.     </li> <li>(U) In FY 2009: Complete cross-domain information sharing research and development to include         collaborative monitoring and management of multi-national enterprise resources. Continue development to include         collaborative</li></ul>	ithin a fon to be and ss a gies for		February IBER AND TITLE and and Cont	
<ul> <li>collaborative monitoring and management of multi-national enterprise resources. Continue dev of techniques and tools that will ensure availability, integrity, and survivability of information v coalition net-centric environment. Investigate technologies, which can determine the pedigree of information in a coalition environment and assess the trustworthiness of the marked up informat shared throughout the coalition. Investigate and prototype the application of information fusior information management technologies such as fuselets to extend composite views of events acr multi-domain enterprise into fused events. Continue development of publish/subscribe technologies publication to a CBDN system for intelligent network management of user information.</li> <li>(U) In FY 2008: Continue cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources. Continue dev of techniques and tools that will ensure availability, integrity, and survivability of information v coalition net-centric environment. Continue to investigate and prototype the application of information v coalition net-centric environment. Investigate such as fuselets to extend composite views of across a multi-domain enterprise into fused events. Continue development of publish/subscribe technologies for application to a content-based delivery networking (CBDN) system for intellig network management of user information. Initiate development of technologies to systematical integrate information sources across COI's.</li> <li>(U) In FY 2009: Complete cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources. Continue development to include collaborative monitoring and management of multi-national enterprise resources. Continue development of user information sharing research and development to include collaborative monitoring and management of multi-national enterprise resour</li></ul>	lopment ithin a f on to be and ss a gies for	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>collaborative monitoring and management of multi-national enterprise resources. Continue dev of techniques and tools that will ensure availability, integrity, and survivability of information v coalition net-centric environment. Continue to investigate and prototype the application of information and information management technologies such as fuselets to extend composite views of across a multi-domain enterprise into fused events. Continue development of publish/subscribet technologies for application to a content-based delivery networking (CBDN) system for intellig network management of user information. Initiate development of technologies to systematical integrate information sources across COI's.</li> <li>(U) In FY 2009: Complete cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources. Continue development</li> </ul>				
(U) In FY 2009: Complete cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources. Continue dev	ithin a mation events query nt			
of techniques and tools that will ensure availability, integrity, and survivability of information of coalition net-centric environment. Continue to investigate technologies, which can determine the pedigree of information in a coalition environment and assess the trustworthiness of the marked information to be shared throughout the coalition. Continue to investigate and prototype the ap of information fusion and information management technologies such as fuselets to extend com- views of events across a multi-domain enterprise into fused events. Continue development of publish/subscribe/query technologies for application to a content-based delivery networking (C system for intelligent network management of user information. Investigate technologies, which determine the pedigree of information in a coalition environment and assess the trustworthiness marked up information to be shared throughout the coalition. Initiate techniques in characteriza an integration of pedigrees across organizational entities.	ithin a p p lication osite DN) can of the			
(U) R-1 Line Item No. 14				

BUDGET ACTIVITY       PE NUMBER AND TITLE       PROJECT NUMBER AND         02 Applied Research       0602702F Command Control and Communications       5581 Command and Technology         (U)       B. Accomplishments/Planned Program (\$ in Millions)       FY 2006       FY 2007       FY 20         (U)       MAJOR THRUST: Develop next generation monitoring, planning, execution, and assessment       9.516       9.909       7.9         (U)       In FY 2006: Developed technologies to dynamically and rapidly assess the battlespace with a special emphasis on effects based assessment. Investigated application of decision support sciences to C2 activities within a Coalition AOC. Extended Course of Action analysis capability to allow collaboration between geographically remote locations. Developed intelligent information systems capable of       PROJECT NUMBER AND	Control (C2) 08 <u>FY 2009</u>
<ul> <li>(U) MAJOR THRUST: Develop next generation monitoring, planning, execution, and assessment</li> <li>9.516</li> <li>9.909</li> <li>7.9 technologies and tools enabling distributed aerospace commanders to efficiently and collaboratively develop effects based campaigns.</li> <li>(U) In FY 2006: Developed technologies to dynamically and rapidly assess the battlespace with a special emphasis on effects based assessment. Investigated application of decision support sciences to C2 activities within a Coalition AOC. Extended Course of Action analysis capability to allow collaboration</li> </ul>	
<ul> <li>technologies and tools enabling distributed aerospace commanders to efficiently and collaboratively develop effects based campaigns.</li> <li>(U) In FY 2006: Developed technologies to dynamically and rapidly assess the battlespace with a special emphasis on effects based assessment. Investigated application of decision support sciences to C2 activities within a Coalition AOC. Extended Course of Action analysis capability to allow collaboration</li> </ul>	24 6.951
(U) In FY 2006: Developed technologies to dynamically and rapidly assess the battlespace with a special emphasis on effects based assessment. Investigated application of decision support sciences to C2 activities within a Coalition AOC. Extended Course of Action analysis capability to allow collaboration	
<ul> <li>supporting joint/coalition C2 for various missions. Developed and applied semantic ontology</li> <li>technologies for use in C2 applications, such as effects-based planning and dynamic tasking. Developed</li> <li>tools to increase situational awareness through intelligent information push and pull in dynamic</li> <li>environments. Investigated intelligent information processing techniques to enhance the C2</li> <li>decision-making process, such as family of web service concepts; secure, shareable object spaces;</li> <li>legacy bridges; component-based architectures; information presentation components; and incorporation</li> <li>of Network Centric Warfare Service concepts. Prototyped these techniques and demonstrated feasibility</li> <li>and usefulness. Explored the application of system of systems and federation of systems engineering</li> <li>principles to enable joint C2 capabilities.</li> </ul>	
<ul> <li>(U) In FY 2007: Complete development of next generation of monitoring, planning, execution, and assessment technologies and tools enabling aerospace commanders to efficiently and collaboratively develop effects-based campaigns. Complete development of technologies to dynamically and rapidly assess the battlespace, and provide near-real-time command of manned and unmanned forces to execute the required missions. Complete the incorporation of decision support science into C2 tools. Complete Course of Action analysis capability to allow collaboration between geographically remote locations. Continue to investigate application of decision support sciences and advanced decision-making concepts to C2 activities within a Coalition AOC. Continue to develop intelligent information systems capable of supporting joint/coalition C2 for various missions in a dynamically changing environment. Continue to develop tools to increase situational awareness through intelligent information processing. Continue the application of systems and federation of systems engineering in the creation of joint C2 capabilities. Explore the application of intelligent software agents as virtual battle staff members to enhance various C2 processes. Develop and demonstrate an effects-based dynamic tasking process enabled by dynamically accessible data and information services.</li> <li>(U) In FY 2008: Continue to investigate application of decision support sciences and advanced</li> </ul>	
R-1 Line Item No. 14       Project 5581     Page-25 of 34       S337	R-2a (PE 0602702F)

	Exhibit R-2a, RDT&E Project Justification February 2007							
	DGET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AN 5581 Command an Technology		and and Con			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> decision-making concepts to C2 activities within a Coalition AOC. Continue information systems capable of supporting joint/coalition C2 for various miss changing environment. Continue to develop tools to increase situational awa through intelligent information processing. Continue the application of syste federation-of-systems engineering in the creation of joint C2 capabilities. Co application of intelligent software agents as virtual battle staff members to en processes. Complete the development and demonstration of an effects-based enabled by dynamically accessible data and information services. Initiate dev a full-spectrum analysis for effects attainment at all levels of a campaign, link desired and undesirable effects. The capability will utilize causal reasoning, I desired end-state, will develop non-deterministic, non-linear causal linkages, reasoning through uncertainty & ambiguity. Initiate research to achieve the a and future impact of an adversary cyber attack on Air Force (AF) information effects-based defense models to help predict the 1st and 2nd order impact of information system/mission. Develop Cyber defense containment scenarios to future adversary impact to net-centric warfare (NCW) mission. In FY 2009: Continue to investigate application of decision support sciences decision-making concepts to C2 activities within a Coalition AOC. Continue information systems capable of supporting joint/coalition C2 for various miss changing environment. Continue to develop tools to increase situational awa through intelligent information processing. Continue the application of syste federation-of-systems engineering in the creation of joint C2 capabilities. Co application of intelligent software agents as virtual battle staff members to en processes. Continue research to achieve the ability to predict the current and adversary cyber attack on AF information systems. Continue the development models to help predict the 1st and 2nd order impact of cyber atta	sions in a dynamically reness and understanding em-of-systems and ontinue to explore the ahance various C2 dynamic tasking process velopment of capability for king leading indicators to linking effects to actions to and will be capable of ability to predict the current in systems. Develop cyber attacks on an that minimize current and and advanced e to develop intelligent sions in a dynamically reness and understanding em-of-systems and ontinue to explore the ahance various C2 future impact of an int of effects-based defense formation system/mission. mize current and future for a full-spectrum analysis o desired and undesirable is to desired end-state, will	FY 2	2007	<u>FY 2008</u>	<u>FY 2009</u>		
Pro	oject 5581	R-1 Line Item No. 14 Page-26 of 34			Exhibit R-2a (	PE 0602702F)		

	Exhibit R-2a, RDT&E Project Justification February 2007						
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Comman Communications		PROJECT NUMBER AND TITLE 5581 Command and Control (C Technology			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> uncertainty & ambiguity.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)							
(U)	MAJOR THRUST: Investigate and develop technologies to implement flexible, h secure, scalable, and survivable information management and dissemination service Information Grid-based COI Infosphere. In FY 2006: Investigated and developed publish, subscribe, and query technologic infosphere that can support thousands of C2 and intelligence, surveillance, and recovarious levels of security classification, and can operate within a coalition warfigh Completed investigation of new advanced publish, subscribe, and query technology Management services, which provide higher levels of performance, security, and se Force net-centric requirements. Completed investigation of techniques to optimize subscribe, and query mechanisms to be used within bandwidth-limited environment automated methods of tailoring the user perspective of the COI Infosphere to redu overload and increase information awareness and utilization. Completed investigati interoperability of various COI Infospheres (e.g., Combat Support, Intel, Business management and sharing of information across them. Developed high payoff pub- query laboratory prototypes which provide higher levels of performance, security, capable of exceeding commercial products and support Air Force Net-centric envi Investigated automated methods of tailoring the user perspective of the COI Infosp information overload and increase information awareness and utilization. Focused composition of tailoring entities, and runtime environments. Investigated methods dynamically evolving the net-centric environment so as to avoid system crashes or information sources arrive or depart the environment. Focused on representation of performance guarantees and negotiation for various levels of service as would be a aircraft. Investigated and assessed the use of semantic markup and semantic web the COI Infosphere. Initiated the investigation of technology and approaches to pu in a COI Infosphere. So as to effectively utilize communication and computing reso technology and techniques to monitor, obtain	ces to enable a Global es enabling a secure connaissance clients at ting environment. gies for the Information scalability to meet Air e these publish, nts. Investigated ce information ation of the ) with respect to the lish, subscribe and and scalability ronment needs. phere to reduce d on automated s and techniques for r latency as new of real-time required in tactical languages as part of rioritizing information purces. Develop e COI Infosphere. web languages as part	3.968	2.177	2.023	1.901	
1	in a COI Infosphere so as to effectively utilize communication and computing reso	ources. Continue to					

	Exhibit R-2a, RDT&E Project Jus	D	February 2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control a Communications		NUMBER AND TITLE mmand and Control (C2) ogy
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> develop high-payoff publish, subscribe, and query laboratory prototypes, which properformance, security, and scalability capable of exceeding commercial products an net-centric environment needs. Continue to investigate automated methods of tailor perspective of the COI Infosphere to reduce information overload and increase infor and utilization. Continue to develop technology and techniques to monitor, obtain f control over the COI Infosphere. Investigate the security policy enforcement betwee at various levels of security classification. Continue to investigate methods and tech dynamically evolving the netcentric environment so as to avoid system crashes or la information sources arrive or depart the environment.	d support Air Force ring the user rmation awareness eedback, and assert en COI Infospheres nniques for	<u>)6 FY 2007</u>	<u>FY 2008</u> <u>FY 2009</u>
(U)	In FY 2008: Continue to develop high-payoff publish, subscribe, and query laborate which provide higher levels of performance, security, and scalability capable of exc products and support Air Force net-centric environment needs. Continue to investig methods of tailoring the user perspective of the COI Infosphere to reduce information increase information awareness and utilization. Continue to develop technology and monitor, obtain feedback, and assert control over the COI Infosphere. Continue to is security policy enforcement between COI Infospheres at various levels of security c Continue to investigate methods and techniques for dynamically evolving the net-cee as to avoid system crashes or latency as new information sources arrive or depart the Initiate decentralization and fault tolerant information management services for the Initiate development of information transformation services and adaptive information services that learn, self-configure, self-manage, and are self-healing. Initiate a study services on demand that will exploit dynamic information services matching end use cell phones, etc.) with appropriate information formats.			
(U)	In FY 2009: Continue to develop high-payoff publish, subscribe, and query laborate which provide higher levels of performance, security, and scalability capable of exc products and support Air Force net-centric environment needs. Develop the security between COI Infospheres at various levels of security classification. Investigate me for dynamically evolving the net-centric environment so as to avoid system crashes exploiting information technologies based on Quality of Service mechanism. Initiat information services across operational boundaries and dissimilar infrastructure base Continue development of information transformation services and adaptive information	eeding commercial y policy enforcement thods and techniques or latency by the integration of ed systems. tion management		
Pro		Item No. 14 -28 of 34		Exhibit R-2a (PE 0602702F)
		340		

	Exhibit R-2a, RDT&E Project J	ustification		DATI	February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Comman Communications	d Control and	PROJECT NUM 5581 Comm Technology		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> services that learn, self-configure, self-manage, and are self-healing. Continue s services on demand that will exploit dynamic information services matching end cell phones, etc.) with appropriate information formats.	-	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop distributed collaboration collaboration science, virtual environments, and predictive simulation tools to fa and fielding of next generation operational collaborative decision support system Congressional Add funding of \$3.8 million in FY 2006 and \$1.0M in FY 2007.	cilitate the development	5.771	6.909	5.431	5.550
(U)	In FY 2006: Developed advanced information technologies for collaborative de knowledge management in support of capability-based planning, Air Force conc next generation planning, execution, and assessment environments. Developed a environment technology for operations other then war and similar applications. Congressionally-directed efforts for an Advanced Collaborative Platform for Ne Control, and for Decision Support Tools. Conducted Congressionally-directed Collaborative Platform for Net-Centric Command and Control (C2), and for Decision Support Tools.	epts of operations, and distributed collaborative Conducted tcentric Command and efforts for an Advanced				
(U)		ollaborative nning and next change protocols, access nologies for advanced cept of Operations and				
(U)	In FY 2008: Continue development of advanced information technologies for co decision-making and knowledge management in support of capability-based plan generation planning, execution, and assessment environments. Continue to proto collaborative environment technologies for advanced decision support for high-p such as the Global Strike Concept of Operations and operations other then war. collaboration services on demand that will exploit dynamic information services devices (laptops, cell phones, etc.) with appropriate information formats. Suppor collaborative user interfaces and semantic interoperability.	nning and next type distributed profile system concepts, Initiate a study on matching end user				
(U)	In FY 2009: Continue development of advanced information technologies for co	llaborative				
Pro		ine Item No. 14 age-29 of 34			Exhibit R-2a (I	PE 0602702F)

(U) <u>B. A</u> deci gene colla such colla devi	Accomplishments/Planned I ision-making and knowledge eration planning, execution, aborative environment techn		Millions)		0602	JMBER AND TIT 702F Comm					
deci gene colla such colla devi colla (U) (U) (U)	ision-making and knowledge eration planning, execution, aborative environment techn		Millions)		•••	munications			chnology	d and Cont	rol (C2)
(U) (U) (U)	h as the Global Strike Conce aboration services on deman ices (laptops, cell phones, etc aborative user interfaces and	ologies for adv pt of Operation d that will expl c.) with appropr	n support of ca environments. anced decision s and operation oit dynamic in iate informatic	Continue to p support for his is other then w formation serve	rototype distrib gh-profile syste ar. Continue s ices matching e	outed em concepts, tudy on end user	<u>FY 2(</u>	<u>)06 F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)			1								
	al Cost						44.8	310	49.696	39.876	35.584
(U) <u>C. O</u>	Other Program Funding Su	<u>mmary (\$ in N</u>	<u>lillions)</u>								
		<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete	Total Cost
<ul><li>(U) PE 0</li><li>Appl</li><li>(U) PE 0</li><li>Com</li></ul>	nmunications-Computer										
RDT (U) PE 0 Deve	0603789F, C3I Advanced elopment.										
coor Relia harm	project has been dinated through the ance 21 process to nonize efforts and inate duplication.										
Project 55				ŀ	R-1 Line Item No. Page-30 of 34						PE 0602702F)

Exhibit R-2a, R	DATE February 2007	
JDGET ACTIVITY 2 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology
J) <b>D. Acquisition Strategy</b> Not Applicable.		
	R-1 Line Item No. 14	
Project 5581	Page-31 of 34	Exhibit R-2a (PE 0602702

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on				DATE	February :	2007
	ET ACTIVITY oplied Research				06027	IBER AND TITL 02F Comma nunications		and			R AND TITLE	ork Tech
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 201		FY 2013	Cost to	Total
( ( ( ) )		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimat		Estimate	Complete	
66SP		0.000	16.130	17.217	11.095	9.987	10.243	10.0		10.193	Continuing	TBD
Note	Quantity of RDT&E Articles In FY 2007, Project 6266SP, Space	0	0 rk Taabnalaar	0	0 transformed fr	0 0 DE 060250	0 DE Multidia	inlinery S	0	0	Drojaat 5082	Ontical
	orking Technology, in order to more e	-				0111 FE 000230	JOF, Multulst	apinary S	pace re	echnology,	, Floject 5082	, Optical
	This project develops the technology between platforms. As the application communications capacities are thousa emerging communication and information protical Code Division Multiple Access benefits associated with the advanced echnology to integrate current Radio software to support them. These technics communications at the theater level, a	of laser-based nds of times gr ation technolog s (CDMA) and fiber optic, wi Frequency (RI cologies have p	, point-to-poin reater than cur ties, for applic l Wavelength reless, platfor otential applic	nt communica rent commun ations in air a Division Mul m, and satellin ata rate Optica cations in spece	ations between ications satelli and space. This tiplexed (WM te networks that al Laser comm cific military s	satellites eme tes, become a s project will e D) transceiver at can be built nunications, alo ystems includ	rges, air and s realistic possi explore technors and prototyp from them. T ong with netw ing reliable, h	pace-base bility. Thi logies for be network his project ork manag igh bandw	d optica s projec implem cs, built will de gement ridth, jau	al networks et will asse nenting pho to demons evelop and techniques m-resistan	s, whose ess and adapt t otonic chip sc strate the demonstrate s, tools and t	
(U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop and asso environment. In FY 2006: Not Applicable.			gies for appli	cation in the sp	bace	<u>FY 20</u> 0.0		<u>FY 20</u> 1.5		<u>FY 2008</u> 1.520	<u>FY 2009</u> 3.030
(U) (U)	In FY 2007: Complete demonstration optical data router and optical backbo multi-gigabit optical network with 16 In FY 2008: Complete demonstration for integration with on board Integrat multi-wavelength optical network for In FY 2009: Continue development of	ne interface ch x 16 optical d n of 16 x 16 op ed Core Proces on-board air a	tips. Initiate d ata router and tical data rout sor. Initiate d nd space appl	lemonstration optical backb er and optical lesign and dev ications	of highly inter oone interface of backbone inter velopment of 4	grated chips. erface chips 0 channel						
	and space applications			gui optical ne								
(U)	MAJOR THRUST/CONGRESSION CDMA and WDM modulation schem This thrust contains \$1.1M in Congre	es and protoco	ls for use in s	pace-based op			0.0	00	4.1	10	3.574	1.833
Proje	ct 66SP				Line Item No. 1 Page-32 of 34 <b>344</b>	4					Exhibit R-2a (P	E 0602702F)

	Exhibit R-2a, RDT&E Project Just	ification	DA	February	2007	
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control a Communications		PROJECT NUMBER AND TITLE 66SP Space Optical Netwo		
(U) (U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2006: Not Applicable. In FY 2007: Continue design and development of optical burst switching and optical protocols for applicability to air and space-based optical networks. Continue flight d industry standard single mode optical communications bus interface chip for airborned Develop and demonstrate a compact, highly integrated optical interconnect for space networking through research placing greater emphasis on wavelength division multip rather than spatial parallelism. Conduct Congressionally directed effort for Massivel Interconnects.	emonstration of platforms. based optical lexing (WDM)	<u>)6 FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	In FY 2008: Continue design and development of optical burst switching and optical protocols for applicability to air and space-based optical networks. Complete flight of industry standard single mode optical communications bus interface chip for airborne. In FY 2009: Initiate flight demonstration of multi gigabit multi wavelength optical of interface chip for space and air platforms.	lemonstration of platforms				
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate heterogene secure, self-configuring high capacity air/space/surface wireless networks that integr- high data rate Optical Laser communications. NOTE: This thrust contains \$1.6M in funding.	ate current RF with	0 8.294	12.123	6.232	
(U) (U)	In FY 2006: Not Applicable. In FY 2007: Continue design and development of waveform, coding, management, a mitigation technologies for a combined RF/laser communications terminal. Demons of industry standard single mode optical communications bus for airborne platforms air-to-ground RF and laser networked communication. Develop and demonstrate a transmaged, directly modulated laser transmitter for extremely high data rates in free sp communications. Conduct Congressionally directed effort for Digital Free-Space Op Transmitter Modems.	rate development and air-to-air or unable chirp ace optical				
(U)	In FY 2008: Complete the characterization of the combiner RF/laser communication Design and develop higher throughput RF waveform data link technology for operative weather conditions. Conduct flight demonstration of combined RF/laser communicate cooperation with the demonstration of advanced airborne sensor technologies.	on under adverse				
(U)	In FY 2009: Complete the development and start the characterization of higher through	ghput RF				
Pro	pject 66SP Page-	em No. 14 i3 of 34 45		Exhibit R-2a (I	PE 0602702F)	

			DATE		
Exhibit R-2a, RDT&E Project Ju	stification			February	2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND T 0602702F Comm Communication	nand Control and	PROJECT NUME 66SP Space (	BER AND TITLE	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
waveform data link technology for operation under adverse weather conditions. In integrated RF/laser communications airborne qualifiable brassboard.	nitiate the design of an	0.000		0.000	0.000
<ul><li>(U) CONGRESSIONAL ADD: Space Qualified Common Data Link</li><li>(U) In FY2006: Not Applicable</li></ul>		0.000	2.192	0.000	0.000
<ul> <li>(U) In FY2007: Develop space qualified Common Data Link hardware, and extend the hardware to insure the hardware will have an environmental robustness to operate environment</li> <li>(U) In FY2008: Not Applicable</li> <li>(U) In FY2009: Not Applicable</li> </ul>					
(U) (U) Total Cost		0.000	16.130	17.217	11.095
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>					
	X 2009FY 2010stimateEstimate	<u>FY 2011</u> <u>FY 201</u> <u>Estimate</u> Estima		Cost to Complete	TOTAL COST
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0603789F, C3I Advanced Development.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>					
(U) <u>D. Acquisition Strategy</u> Not Applicable. B-11i	ne Item No. 14				
	ge-34 of 34			Exhibit R-2a (F	PE 0602702F)
UNC	346 _ <b>ASSIFIED</b>				

#### PE NUMBER: 0602805F PE TITLE: Dual Use Science & Technology

	Exhibit R-2,	RDT&E Bi	udget Iten	n Justifica	tion			DATE	February 2	2007
BUDGET ACTIVITY 02 Applied Research					BER AND TITL	E e Science &	Technology	•		2007
Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
, , ,	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE)	Cost 0.962	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TB
4770 Dual Use Science and Technology (S&T)	0.962	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TB
Note: In FY 2006, this PE was cancel	lled as a result of hig	her Air Force	priorities.							
technologies and to promote mo requirement from industry and s successfully demonstrated techn advanced materials and manufac systems sustainment. This prog evolutionary and revolutionary t	specific Air Force pr nologies. Specific pr cturing; sensors; adv ram is in Budget Ac	ograms. The cojects are dete anced propulsion	cooperative fu rmined throug ion, power, ar	nding assures gh annual com nd fuel efficier	joint commitr petitive solici cy; informatio	nent to the tran tations. Technon on and commu	nsition and du nology areas c nnications tech	al use develop onsidered may mologies; and	oment efforts o y include weapon	of
U) <u>B. Program Change Summary</u>	0				<u>FY 20</u>	006	<u>FY 2007</u>	FY	2008	<u>FY 2009</u>
U) Previous President's Budget					0.9		0.000			
U) Current PBR/President's Budget	t				0.9		0.000			
<ul><li>U) Total Adjustments</li><li>U) Congressional Program Reduction</li></ul>					-0.0	024				
<ul> <li>Congressional Program Reduction Congressional Rescissions</li> <li>Congressional Increases</li> <li>Reprogrammings</li> <li>SBIR/STTR Transfer</li> <li>Significant Program Changes: In FY 2006, this PE was cancell</li> </ul>		ner Air Force p	priorities.		-0.0	24				
<ul><li>C. Performance Metrics</li><li>(U) Under Development</li></ul>	C	Ĩ								

l l	Exhibit R-	2a, RDT&I	E Project	Justificati	on			DATE	February 2	2007
BUDGET ACTIVITY 02 Applied Research				06028	MBER AND TITI 805F Dual Us 10logy	LE Se Science 8	47	OJECT NUMBE 70 Dual Use chnology (S	Science an	d
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4770 Dual Use Science and Technology (S&T)	0.962	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles Note: In FY 2006, this PE was cancelled as	0 a result of hig	0 gher Air Force	0 priorities.	0	0	0	0	0		
<ul> <li>This program seeks to leverage industr objective of this program is for the Air technologies and to promote more affor requirement from industry and specific successfully demonstrated technologie advanced materials and manufacturing systems sustainment. This program is evolutionary and revolutionary technologie</li> <li>(U) <u>B. Accomplishments/Planned Progr</u></li> <li>(U) CONGRESSIONAL ADD: Project H</li> <li>(U) In FY 2006: Conducted Congression</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable</li> </ul>	Force to stim ordable defens c Air Force press. Specific pr statistic sensors; adv in Budget Ac logies. am (\$ in Mill MA	nulate the deve e systems that ograms. The o rojects are dete anced propuls tivity 2, Appli	lopment of d maintain bat cooperative free ermined throu ion, power, a ed Research,	ual use techno tlespace super unding assures igh annual coi nd fuel efficie	logies so as to iority. A critic s joint commit npetitive solic ncy; informati	provide great cal component ment to the tra itations. Tech on and commu-	er access to co of this progra nsition and du nology areas of inications tech ical feasibility 06 <u>F</u>	ommercially d am is the cost- ial use develop considered ma hnologies; and	eveloped sharing oment efforts o y include l weapon	-
<ul><li>(U) In FY 2009: Not Applicable</li><li>(U) Total Cost</li></ul>						0.9	62	0.000	0.000	0.000
	<u>2006</u> <u>F</u>	<u>Y 2007</u> <u>F</u>	T <u>Y 2008</u> Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> Estimate	<u>FY 2012</u> <u>Estimate</u>	FY 2013 Estimate	<u>Cost to</u> Complete	<u>Total Cos</u> t
Project 4770			R-1	Line Item No. Page-2 of 4 348	15				Exhibit R-2a (P	E 0602805F)

Exhibit R-2a, RDT&E Project Justification									
ch PE NUMBER AND TITLE 0602805F Dual Use Scie Technology	ence & 4770 I	February 2007 CT NUMBER AND TITLE Dual Use Science and pology (S&T)							
am Funding Summary (\$ in Millions)									
luman									
erospace									
erospace									
ry Space									
pace									
onventional									
virected									
ogy.									
ommand									
nmunications.									
dvanced									
eapon									
dvanced									
DIS.									
erospace									
erospace									
Power									
have Constants									
rew Systems									
rotection									
lastropia									
lectronic									
R-1 Line Item No. 15									
Page-3 of 4		Exhibit R-2a (PE 0602805F							
349									
Page-3 of	4	4							

Exhibit R-2a, RD	DATE February 2007	
UDGET ACTIVITY 2 Applied Research	PE NUMBER AND TITLE 0602805F Dual Use Science Technology	PROJECT NUMBER AND TITLE
U) C. Other Program Funding Summary (\$ in Millions)		
Combat Technology.		
J) PE 0603401F, Advanced		
Spacecraft Technology.		
U) PE 0603500F,		
Multi-Disciplinary Advanced		
Development Space		
Technology.		
U) PE 0603601F, Conventional		
Weapons Technology. J) PE 0603605F, Advanced		
Weapons Technology.		
J) PE 0603789F, C3I Advanced		
Development.		
This program has been coordinated through the Reliance 21	process to harmonize efforts and eliminate duplication	
<ul> <li>U) <u>D. Acquisition Strategy</u></li> </ul>		
Not Applicable.		
Not Applicable.		
	R-1 Line Item No. 15	
Project 4770	Page-4 of 4	Exhibit R-2a (PE 0602805

#### PE NUMBER: 0602890F PE TITLE: High Energy Laser Research

FY 2006 Actual st 50.271 50.271 et Item Justifica Defense (DoD) I cluding speed-of a wide variety of a wide variety of and the ultra-pre mology program ce missions whi reas such as cher treas such as che	high energy lass -light velocity, f military miss cision negation . In general, e e complement nical lasers, so ogy Developme	high precisions sions includin n of targets in fforts funded ing Service/A solid state laser ent. This prog	060289 FY 2009 Estimate 51.159 51.159 blied research th on, significant r g interception of urban environ under this prog gency program s, beam controo gram is in Bud	FY 2010 Estimate 58.588 58.588 hrough the HE magazine dept of ballistic mis ments with litt gram are chose ns that are dire l, optics, prop	FY 2011 Estimate 58.572 58.572 EL Joint Techrich, low-cost per ssiles in boost the or no collate en for their po ected at more se agation, and fi , Applied Reset	FY 2012 Estimate 55.985 55.985 nology Office er kill, and red phase; defeat teral damage. tential to have specific Servio ree electron la earch, since it	FY 2013 Estimate 57.008 57.008 (JTO). HEL luced logistics of high-speed This program e major impac ce needs. A basers. Note: In develops and	a requirements d, maneuverin h is part of an t on multiple road range of h FY 2007,	Total TB TB ms g
Actualst50.27150.271et Item JustificaDefense (DoD) Icluding speed-ofa wide variety cola an="2">a wide variety	Estimate 52.136 52.136 high energy las -light velocity, f military miss cision negation . In general, e e complement nical lasers, so ogy Developme	Estimate 50.303 50.303 ser (HEL) app high precisions includin of targets in fforts funded ing Service/A blid state laser ent. This prog	Estimate 51.159 51.159 blied research th on, significant r g interception urban environ under this prog agency program s, beam contro gram is in Bud	Estimate 58.588 58.588 hrough the HE magazine dept of ballistic mis ments with litt gram are chose as that are dired l, optics, prop get Activity 2, <u>FY 20</u>	Estimate 58.572 58.572 EL Joint Techr th, low-cost per ssiles in boost the or no collat en for their po ected at more s agation, and fi , Applied Rese	Estimate 55.985 55.985 ology Office er kill, and red phase; defeat teral damage. tential to have specific Servio ree electron la earch, since it	Estimate 57.008 57.008 (JTO). HEL luced logistics of high-speed This program e major impac ce needs. A basers. Note: In develops and	Complete Continuing Continuing weapon system requirements d, maneuverinn is part of an it on multiple road range of n FY 2007, determines th	TB TB ms g e <u>FY 2009</u>
st 50.271 50.271 et Item Justifica Defense (DoD) I cluding speed-of a wide variety of and the ultra-pre mology program ce missions whi reas such as cher Laser Technolo lity of evolution	52.136 52.136 tion high energy las light velocity, f military miss cision negation . In general, e e complement nical lasers, so ogy Developme	50.303 50.303 ser (HEL) app high precisions includin n of targets in fforts funded ing Service/A blid state laser ent. This prog	51.159 51.159 blied research th on, significant r g interception of urban environ under this prog gency program s, beam contro gram is in Bud	58.588 58.588 hrough the HE magazine dept of ballistic mis ments with litt gram are chose ns that are dire l, optics, prop get Activity 2, <u>FY 20</u>	58.572 58.572 EL Joint Techr th, low-cost pe ssiles in boost tle or no collat en for their po ected at more s agation, and fi , Applied Rese	55.985 55.985 ology Office or kill, and red phase; defeat teral damage. tential to have specific Servio ree electron la earch, since it <u>FY 2007</u>	57.008 57.008 (JTO). HEL luced logistics of high-speed This program e major impac ce needs. A be asers. Note: In develops and	Continuing Continuing weapon system requirements d, maneuverin h is part of an t on multiple road range of h FY 2007, determines th	<u>TB</u> ms g e <u>FY 2009</u>
50.271 et Item Justifica Defense (DoD) I cluding speed-of a wide variety of and the ultra-pre mology program ce missions white reas such as chere to Laser Technolo lity of evolution	52.136 nigh energy las -light velocity, f military miss cision negation . In general, e e complement nical lasers, so ogy Developme	50.303 eer (HEL) app high precisions includin of targets in fforts funded ing Service/A blid state laser ent. This prog	51.159 blied research th on, significant r g interception urban environ under this prog gency program s, beam contro gram is in Bud	58.588 hrough the HE magazine dept of ballistic mis ments with litt gram are chose ns that are dire l, optics, prop get Activity 2, <u>FY 20</u>	58.572 EL Joint Techrich, low-cost persiles in boost tle or no collate en for their portected at more se agation, and fr , Applied Reserved	55.985 nology Office er kill, and red phase; defeat teral damage. tential to have specific Servio ree electron la earch, since it	57.008 (JTO). HEL luced logistics of high-speed This program e major impac ce needs. A be asers. Note: In develops and	Continuing weapon system requirements d, maneuverin is part of an it on multiple road range of n FY 2007, determines th	<u>TB</u> ms g e <u>FY 2009</u>
et Item Justifica Defense (DoD) l cluding speed-of a wide variety of and the ultra-pre mology program ce missions white reas such as cher Laser Technolo lity of evolution	ition high energy las -light velocity, f military miss cision negation . In general, e e complement nical lasers, so ogy Developme	er (HEL) app high precisions includin of targets in fforts funded ing Service/A blid state laser ent. This prog	blied research the on, significant r g interception urban environ under this prog agency program s, beam contro gram is in Bud	hrough the HE magazine dept of ballistic mis ments with litt gram are chose ns that are dire l, optics, prop get Activity 2, <u>FY 20</u>	EL Joint Techrich, low-cost pessiles in boost the or no collate or no collate or for their posted at more stragation, and from the section of	hology Office or kill, and red phase; defeat teral damage. tential to have specific Service ree electron la earch, since it	(JTO). HEL luced logistics of high-speed This program e major impac ce needs. A basers. Note: In develops and <u>FY</u>	weapon system requirements d, maneuverin n is part of an et on multiple road range of n FY 2007, determines th	ms g e <u>FY 2009</u>
Defense (DoD) l cluding speed-of a wide variety of and the ultra-pre mology program ce missions whi reas such as cher Laser Technolo lity of evolution	high energy lass -light velocity, f military miss cision negation . In general, e e complement nical lasers, so ogy Developme	high precisions sions includin n of targets in fforts funded ing Service/A solid state laser ent. This prog	on, significant n g interception urban environ under this prog gency program s, beam contro gram is in Bud	magazine dept of ballistic mis ments with litt gram are chose ns that are dire l, optics, prop get Activity 2, <u>FY 20</u>	th, low-cost pessiles in boost tle or no collat en for their po ected at more s agation, and fi , Applied Rese	er kill, and red phase; defeat teral damage. tential to have specific Servic ree electron la earch, since it <u>FY 2007</u>	luced logistics of high-speed This program e major impac ce needs. A b asers. Note: In develops and <u>FY</u>	a requirements d, maneuverin h is part of an t on multiple road range of h FY 2007, determines th	e <u>FY 2009</u>
<u>in Millions</u> )									
						50.166		0 202	51 150
				50.2 3.6		52.136 -0.032	5	0.303	51.159
				-0.0	02	-0.198			
						3.200 -1.000			
		R-1		5					
			R-1	Page-1 of 7	4.8 -1.2 R-1 Line Item No. 16 Page-1 of 7	4.824 -1.220 R-1 Line Item No. 16 Page-1 of 7	3.200 4.824 -1.000 -1.220 R-1 Line Item No. 16 Page-1 of 7	3.200 4.824 -1.000 -1.220 R-1 Line Item No. 16 Page-1 of 7	3.200 4.824 -1.000 -1.220

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY oplied Research					IBER AND TITL 90F High En rch			OJECT NUMBE 96 High Ene		Research
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5096		50.271	52.136	50.303	51.159	58.588	58.572	55.985	57.008	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	This program funds Department of De- nave many potential advantages, inclu- HELs have the potential to perform a anti-ship and anti-aircraft missiles; an overall DoD HEL Science and Techno HEL systems and on multiple Service technologies are addressed in key area Congress added \$2.2 million for Air L technical feasibility and military utilit	iding speed-of wide variety o d the ultra-pre plogy program missions whil as such as cher Laser Technolo	-light velocity f military miss cision negation . In general, e le complement nical lasers, so ogy Developm	, high precisions sions includin n of targets in efforts funded ting Service/A polid state laser ent. This pro-	on, significant g interception urban environ under this pro Agency program rs, beam contro gram is in Bud	magazine dep of ballistic mi ments with lit gram are chos ns that are dir ol, optics, prop	th, low-cost po ssiles in boost tle or no colla en for their po ected at more pagation, and f	er kill, and rec t phase; defeat teral damage. otential to hav specific Servi free electron la	luced logistics of high-speed This program e major impac ce needs. A b asers. Note: In	s requirements d, maneuverir h is part of an et on multiple broad range of h FY 2007,	s. Ig
(U)	B. Accomplishments/Planned Prog	ram (\$ in Mill	lions)	-	-		FY 20	06 FY	<u> 2007</u>	<u>FY 2008</u>	FY 2009
(U) (U) (U) (U)	MAJOR THRUST: Advance solid-st demonstrations up to a Technology R In FY 2006: Awarded contracts for p project, to demonstrate 100 kilowatt 1 improve field ability of solid state lass In FY 2007: Participate in the 100 ki applied research projects (e. g. long-li amplifiers) for future advanced demon In FY 2008: Continue to participate i government-sponsored measurements director development effort, suitable f In FY 2009: The 100 kilowatt labora the joint high-power beam director de laser device.	eadiness Leve hase III of the aser devices. ers. lowatt JHPSSI ife diode laser nstration of so in the 100 kilo s of the 100 kilo for mating with tory demonstra- evelopment eff	l of 6. Joint High Po Conducted neo L demonstratio drivers, thin-d lid state laser s watt JHPSSL lowatt laser(s). h the JHPSSL ation will occu	ower Solid Sta cessary studie on. Analyze s lisc amplifiers systems. project. Prov. Initiate a joi phase III lase or during this or mating with	te Laser (JHPS s to understand successful piece and fiber lase ide for indeper int high-power er device. period. Contir n the JHPSSL p	d and es from er ndent beam nue with bhase III	10.9		10.524	10.271	9.424
(U)	MAJOR THRUST: Mature technolog fieldable solid-state laser devices	gies that will p	provide system	-			8.7	20	7.733	8.232	8.686
Proje	ect 5096			R-1	Line Item No. 10 Page-2 of 7	6				Exhibit R-2a (F	PE 0602890F)
^					352					, , , , , , , , , , , , , , , , , , ,	

	Exhibit R-2a, RDT&E Project Jus	tification		DATI	February	2007
	GET ACTIVITY pplied Research	PE NUMBER AND TITL 0602890F High En Research			UMBER AND TITLE Energy Laser Research	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	In FY 2006: Conducted research to enable power scaling with reduced optical disto efficiency, and improved mass/weight characteristics. Developed scaleable architect combining. Examined architecture improvements, such as elimination of free-space systems. Conducted an industry proposal call for FY 2006; awarded eight contracts	tures for beam optics in fiber				
(U)	in FY 2007: Develop technology that will lead to improved laser gain material and suitable for beam combination. Improve the efficiency and reliability of diode pump Service and Agency proposal call for FY 2007.					
(U)	In FY 2008: Develop technology that will lead to improved fieldability, serviceabil Develop power scaling architectures with good beam quality and suitable mass and industry proposal call for FY 2008.					
(U)	In FY 2009: Develop technology that will lead to improved fieldability, serviceabil Develop power scaling architectures with good beam quality and suitable mass and Service and Agency proposal call for FY 2009.					
(U)						
(U)	MAJOR THRUST: Investigate new technologies that have revolutionary potential applications.	for HEL	2.199	2.189	2.411	2.529
(U)	In FY 2006: Explored novel laser technologies to have increase efficiency and decr Integrated short-pulse laser technology into this initiative. Conducted an industry pr 2006, awarded three contracts.					
(U)	In FY 2007: Explore novel laser technologies to increase efficiency and decrease m Integrate short-pulse laser technology into this initiative. Conduct a Service and Ag for FY 2007.					
(U)	In FY 2008: Explore novel laser technologies to increase efficiency and decrease m Conduct a Service and Agency proposal call for FY 2008.	ass/volume.				
(U)	In FY 2009: Explore novel laser technologies to increase efficiency and decrease m Conduct a Service and Agency proposal call for FY 2009.	ass/volume.				
(U)						
(U)	MAJOR THRUST: Explore free electron lasers (FEL) that have potential in future Conduct system level technology development and trade studies to facilitate scaling weapons-class power levels and shipboard integration.	FELs to	9.330	9.463	10.028	10.153
(U)	In FY 2006: Conducted research in power scaling for a 100 kilowatt class FEL. De	esigned				
Pro		Item No. 16 e-3 of 7			Exhibit R-2a (I	PE 0602890F)
		353				

Research		Exhibit R-2a, RDT&E Project Jus	PE NUMBER AND TITLE       PROJECT NUMBER AND TITLE         0602890F High Energy Laser       PROJECT NUMBER AND TITLE         5096 High Energy Laser Research         FY 2006       FY 2007       FY 2008       FY 2009         ble beam-breakup thresholds, and power       FY 2006       FY 2007       FY 2008       FY 2009         ble beam-breakup thresholds, and power       ft testing with the 10 kilowatt laboratory       fts. Conducted an industry proposal call       FY 2007       FY 2008       FY 2009         and injector capability, suitable       nator. Complete the 10 kilowatt       caling for FY 2007.       caling to a 100 kilowatt lab       caling to a 100 kilowatt lab				
high-average-current photocathode and injector capability, suitable beam-breakup thresholds, and power scaling capability of the optical resonator. Continued component testing with the 10 kilowatt laboratory device to define a development path for scaling to a 100 kilowatts. Conducted an industry proposal call for FY 2006. Awarded seven contracts.         (U)       In FY 2007: Demonstrate high average current photocathode and injector capability, suitable beam-breakup thresholds, and power scaling of the optical resonator. Complete the 10 kilowatt laboratory demonstration. Conduct a Service and Agency proposal call for FY 2007.         (U)       In FY 2008: Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct an industry proposal call for FY 2009.         (U)       In FY 2009: Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct a fundatry proposal call for FY 2009.         (U)       In FY 2009: Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct a laboratory depresention technology experiments to select promising chemical generator and chemical regeneration technologies that can be scaled for weapons application.       5.420       7.303       5.690         (U)       In FY 2006: Developed and demonstrate closed-cycle chemical laser, focused on chemical oxygen iodine (COIL) devices. Explored novel concepts on electric-oxygen pumping schemes to minimize the chemistry. Develop electric gas phase laser generation. Conducted an industry proposal call for FY 2009.       5.420       7.303       5.690         (U)       In FY 2007: Demonstrate closed-cycle CoIL devices. Demonstrate clo			0602890F High End				Research
beam-breakup thresholds, and power scaling of the optical resonator. Complete the 10 kilowatt       laboratory demonstration. Conduct a Service and Agency proposal call for FY 2007.         (U)       In FY 2008: Continue to investigate the development path for scaling to a 100 kilowatt lab         demonstration. Conduct an industry proposal call for FY 2008         (U)       In FY 2009: Continue to investigate the development path for scaling to a 100 kilowatt lab         demonstration. Conduct a Service and Agency proposal call for FY 2009.         (U)       MAJOR THRUST: Conduct technology experiments to select promising chemical generator and       5.420       7.303       5.690         (U)       MAJOR THRUST: Conduct technologies that can be scaled for weapons application.       5.420       7.303       5.690         (U)       In FY 2009: Developed and demonstrated closed-cycle chemical laser, focused on chemical oxygen       5.420       7.303       5.690         (U)       In FY 2007.       Demonstrate closed-cycle COLL devices. Demonstrate laser generation. Conducted an industry proposal for FY 2006, awarded five contracts.       Conduct a Service and Agency proposal call for FY 2008.       5.420       7.303       5.690         (U)       In FY 2007.       Demonstrate closed-cycle COLL devices. Demonstrate electric-oxygen pumping schemes       5.420       7.303       5.690         (U)       In FY 2009.       Demonstrate closed-cycle chemical lasers. Explore novel concepts on e		high-average-current photocathode and injector capability, suitable beam-breakup th scaling capability of the optical resonator. Continued component testing with the 10 device to define a development path for scaling to a 100 kilowatts. Conducted an in for FY 2006, awarded seven contracts.	) kilowatt laboratory dustry proposal call	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
demonstration. Conduct an industry proposal call for FY 2008         (U)       In FY 2009; Continue to investigate the development path for scaling to a 100 kilowatt lab demonstration. Conduct a Service and Agency proposal call for FY 2009.         (U)       MAJOR THRUST: Conduct technology experiments to select promising chemical generator and 5.420 7.303 5.690         (U)       In FY 2006: Developed and demonstrated closed-cycle chemical laser, focused on chemical oxygen iodine (COIL) devices. Explored novel concepts on electric-gas phase laser generation. Conducted an industry proposal for FY 2006, awarded five contracts.         (U)       In FY 2007: Demonstrate closed-cycle colL devices. Demonstrate electric-oxygen pumping schemes to minimize the chemistry. Develop electric-gas phase laser generation technologies. Fund Air Laser Project to produce oxygen deltlets through electric pumping. Conduct a Service and Agency proposal call for FY 2008.         (U)       In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a service and Agency proposal call for FY 2008.         (U)       In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.         (U)       In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.         (U)       In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.		beam-breakup thresholds, and power scaling of the optical resonator. Complete the laboratory demonstration. Conduct a Service and Agency proposal call for FY 2007	10 kilowatt 7.				
demonstration. Conduct a Service and Agency proposal call for FY 2009.         (U)         (I)         (I)         (I)         (I)         (I)         (I)         (U)         (U)         (U)         (U)         (U)         (U)         (U)         (U)         (U)	(U)	demonstration. Conduct an industry proposal call for FY 2008					
<ul> <li>(U) MAJOR THRUST: Conduct technology experiments to select promising chemical generator and chemical regeneration technologies that can be scaled for weapons application.</li> <li>(U) In FY 2006: Developed and demonstrated closed-cycle chemical laser, focused on chemical oxygen iodine (COIL) devices. Explored novel concepts on electric-gas phase laser generation. Conducted an industry proposal for FY 2006, awarded five contracts.</li> <li>(U) In FY 2007: Demonstrate closed-cycle COIL devices. Demonstrate electric-oxygen pumping schemes to minimize the chemistry. Develop electric-gas phase laser generation technologies. Fund Air Laser Project to produce oxygen deltlets through electric pumping. Conduct a Service and Agency proposal call for FY 2007.</li> <li>(U) In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2008.</li> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.</li> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and integrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>			vatt lab				
<ul> <li>chemical regeneration technologies that can be scaled for weapons application.</li> <li>(U) In FY 2006: Developed and demonstrated closed-cycle chemical laser, focused on chemical oxygen iodine (COIL) devices. Explored novel concepts on electric-gas phase laser generation. Conducted an industry proposal for FY 2006, awarded five contracts.</li> <li>(U) In FY 2007: Demonstrate closed-cycle COIL devices. Demonstrate electric-oxygen pumping schemes to minimize the chemistry. Develop electric pumping. Conduct a Service and Agency proposal call for FY 2007.</li> <li>(U) In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2008.</li> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call ser generation. Conduct a Service and Agency proposal calls for FY 2009.</li> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and integrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>	(U)						
<ul> <li>iodine (COIL) devices. Explored novel concepts on electric-gas phase laser generation. Conducted an industry proposal for FY 2006, awarded five contracts.</li> <li>(U) In FY 2007: Demonstrate closed-cycle COIL devices. Demonstrate electric-oxygen pumping schemes to minimize the chemistry. Develop electric-gas phase laser generation technologies. Fund Air Laser Project to produce oxygen deltlets through electric pumping. Conduct a Service and Agency proposal call for FY 2007.</li> <li>(U) In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2008.</li> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.</li> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.</li> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and integrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>	(U)		generator and	5.420	7.303	5.690	6.057
<ul> <li>(U) In FY 2007: Demonstrate closed-cycle COIL devices. Demonstrate electric-oxygen pumping schemes to minimize the chemistry. Develop electric-gas phase laser generation technologies. Fund Air Laser Project to produce oxygen deltlets through electric pumping. Conduct a Service and Agency proposal call for FY 2007.</li> <li>(U) In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2008.</li> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.</li> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.</li> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and nitegrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>	(U)	iodine (COIL) devices. Explored novel concepts on electric-gas phase laser generat					
<ul> <li>(U) In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct an industry proposal call for FY 2008.</li> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.</li> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and 8.560 8.918 9.615 integrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>	(U)	to minimize the chemistry. Develop electric-gas phase laser generation technologies. Project to produce oxygen deltlets through electric pumping. Conduct a Service and	s. Fund Air Laser				
<ul> <li>(U) In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on electric-gas phase laser generation. Conduct a Service and Agency proposal call for FY 2009.</li> <li>(U)</li> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and 8.560 8.918 9.615 integrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>	(U)	In FY 2008: Demonstrate closed-cycle chemical lasers. Explore novel concepts on	electric-gas phase				
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and 8.560 8.918 9.615 integrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>	(U)	In FY 2009: Demonstrate closed-cycle chemical lasers. Explore novel concepts on	electric-gas phase				
<ul> <li>(U) MAJOR THRUST: Develop technology to support high performance beam control systems and 8.560 8.918 9.615 integrated demonstrations.</li> <li>(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control</li> </ul>	(U)						
(U) In FY 2006: Explored advanced component and control techniques for difficult environments, such as high speed flight, high turbulence, and extended ranges. Advanced high performance beam control	· /		systems and	8.560	8.918	9.615	10.234
	(U)	In FY 2006: Explored advanced component and control techniques for difficult env high speed flight, high turbulence, and extended ranges. Advanced high performance	ce beam control				
R-1 Line Item No. 16       Project 5096     Page-4 of 7       S54	Pro	ject 5096 Page	e-4 of 7			Exhibit R-2a (	PE 0602890F)

	Exhibit R-2a, RDT&E Project Just	tification		DATE	- February	2007
	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602890F High Ener Research			I BER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> of atmospheric limitations at low altitude, such as turbulence, thermal blooming, and disturbances. Conducted an industry proposal for FY 2006, awarded eight contracts	-	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Develop beam control technologies, such as all-fiber systems with contactive controls for boundary layer mitigation. Complete atmospheric compensation Conduct a Service and Agency proposal call for FY 2007.	formal apertures and				
(U)	In FY 2008: Develop/provide beam control technology options for laser weapon use platforms (aircraft, ground vehicles and shipboard systems). Conduct an industry p 2008.					
(U)	In FY 2009: Develop/provide beam control technology options for laser weapon use platforms (aircraft, ground vehicles and shipboard systems). Conduct a Service and call for FY 2009.					
(U)						
· /	MAJOR THRUST: Develop a lethality database, and integrate into a systems-level In FY 2006: Developed a predictive, physics-based methodology for prediction of ta on an understanding of the mechanism of laser/target material interaction. Developed be accepted by the HEL community, and integrated in validated models for laser systems.	arget lethality based d databases that will	3.500	3.814	4.056	4.076
	In FY 2007: Catalog existing lethality databases for common use. Develop an archiconsolidate and compare historical data. Initiate laser systems inputs for the Joint M Manual.	unitions Effect				
(U)	In FY 2008: In close coordination with existing HEL models, integrate lethality data campaign-level HEL system models. Develop laser systems inputs for the Joint Mut Manual.					
(U)	In FY 2009: In close coordination with existing HEL models, integrate lethality data campaign-level HEL system models. Develop laser systems inputs for the Joint Mut Manual.					
(U)						
(U)	CONGRESSIONAL ADD: High Power Fiber Laser Program.		1.152	0.000	0.000	0.000
	In FY 2006: Conducted Congressionally-directed effort for the High Power Fiber L	aser Program.				
	In FY 2007: Not Applicable. In FY 2008: Not Applicable.					
	In FY 2009: Not Applicable.					
		tem No. 16				
Pro		-5 of 7 55			Exhibit R-2a (I	PE 0602890F)

		Exhibit	R-2a, RD	F&E Projec	t Justifica	tion			DATE	Fahruar	2007		
BUDGET ACTIVITY 02 Applied Res					PE N 0602	UMBER AND TI	TLE Energy Laser			February 2007 ECT NUMBER AND TITLE High Energy Laser Research			
	olishments/Planned	Program (\$ in	<u>Millions)</u>				<u>FY 20</u>	<u>)06 I</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>		
<ul><li>(U) In FY 2006</li><li>(U) In FY 2007</li></ul>	SSIONAL ADD: Ox 5: Conducted Congre 7: Not Applicable. 3: Not Applicable.			ne Oxygen Laso	er Optical Sour	rce.	0.4	80	0.000	0.000	0.000		
<ul> <li>(U) In FY 2009</li> <li>(U)</li> <li>(U) CONGRES</li> <li>(U) In FY 2006</li> <li>(U) In FY 2007</li> </ul>	<ul> <li>P: Not Applicable.</li> <li>SSIONAL ADD: Air</li> <li>5: Not Applicable.</li> <li>7: Conduct Congressions</li> <li>8: Not Applicable.</li> </ul>				y Developmer	ıt.	0.0	000	2.192	0.000	0.000		
<ul><li>(U) In FY 2009</li><li>(U) Total Cost</li></ul>	9: Not Applicable.						50.2	271	52.136	50.303	51.159		
<ul> <li>(U) PE 0602500 Multi-Discip Technology</li> <li>(U) PE 0601108 Laser Resea</li> <li>(U) PE 0603444 Surveillance</li> <li>(U) PE 0603500 Multi-Discip Developmen Technology</li> <li>(U) PE 0603605 Weapons Te</li> <li>(U) PE 0603924</li> </ul>	plinary Space 7. BF, High Energy arch Initiatives. 4F, Maui Space e System. DF, plinary Advanced nt Space 7. 5F, Advanced echnology.	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complet</u>			
Project 5096				F	R-1 Line Item No Page-6 of 7	. 16				Exhibit R-2a (	PE 0602890F)		

Exhibit R-2a, RDT&E P	roject Justification	DATE February 2007
BUDGET ACTIVITY D2 Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE 5096 High Energy Laser Research
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
<ul> <li>Program.</li> <li>PE 0603883C, Ballistic</li> <li>Missile Defense Boost Phase</li> <li>Segment.</li> <li>PE 0602605F, Directed</li> <li>Energy Technology.</li> <li>PE 0602307A, Advanced</li> <li>Weapons Technology.</li> <li>PE 0602114N, Power</li> <li>Projection Applied Research.</li> <li>This project has been</li> <li>coordinated through the</li> <li>Reliance process to harmonize</li> <li>efforts and eliminate</li> </ul>		
<ul> <li>duplication.</li> <li><b>D. Acquisition Strategy</b> Not Applicable.</li> </ul>		
Project 5096	R-1 Line Item No. 16 Page-7 of 7	Exhibit R-2a (PE 0602890
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#### PE NUMBER: 0603112F PE TITLE: Advanced Materials for Weapon Systems

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
	T ACTIVITY /anced Technology Developme	nt (ATD)			-	IBER AND TITL		for Weapor	Systems		
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	65.193	82.290	39.730	39.324	48.652	46.771	47.742	48.924	Continuing	TBD
2100	Laser Hardened Materials	26.653	35.689	25.610	26.409	34.036	32.012	32.676	33.485	Continuing	TBD
3153	Non-Destructive Inspection Development	13.287	15.885	3.772	3.875	4.389	4.449	4.542	4.653	Continuing	TBD
3946	Materials Transition	19.163	14.755	3.742	3.791	4.276	4.265	4.354	4.461	Continuing	TBD
4918	Deployed Air Base Demonstrations	6.090	10.864	2.216	2.274	2.581	2.625	2.679	2.746	Continuing	TBD
77SP	Advanced Space Materials	0.000	5.097	4.390	2.975	3.370	3.420	3.491	3.579	Continuing	TBD

Note: In FY 2007, Project 77SP, Advanced Space Materials, efforts transfer from PE 0603500F, Multidisciplinary Space Technology, Project 5032, Advanced Space Materials, in order to more effectively manage and provide oversight of the efforts. Funds for the FY 2007 Congressionally-directed Advanced Inspection Techniques and Analysis Methods for Multi-layer Structures and Widespread Fatigue Damage in Aging Military Aircraft in the amount of \$1.1 million are in the process of being moved to PE 0603112F, Advanced Materials for Weapon Systems, from PE 0702207F, Depot Maintenance, for execution.

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

This program develops and demonstrates materials technology for transition into Air Force systems. The program has four projects which develop: (1) hardened materials technologies for the protection of aircrews and sensors; (2) non-destructive inspection and evaluation technologies; (3) transition data on structural and non-structural materials for aerospace applications; and (4) airbase operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Note: In FY 2007, Congress added \$1.2 million for Large Panel Sapphire Producibility, \$2.3 million for Metals Affordability Initiative, \$1.6 million for Encapsulated Ballistic Protection System, \$1.0 million for Combined Agent Fire Fighting System, \$1.0 million for Continuous Integrated Vehicle Health Monitoring System, \$2.0 million for Aging Aircraft Fleet Support - National Institute for Aviation Research, \$1.0 million for Low Observable Multi-Purpose Inspection Tool, \$1.0 million for Coated Field Repair, \$1.0 million for Optical Filters for Hardened Night Vision Goggles, \$1.3 million for Blast-Resistant Barriers and Structural Design for Homeland Defense, \$1.8 million for Advanced Power Technology: Silicon-Carbide Power, Bipolar Junction Transistors, \$2.0 million for Assessing Aging of Military Aircraft, \$3.3 million for Hydrothermal Oxidation (HTO) for Alaska, \$2.0 million for Materials Integrity Management Research for AF Systems, \$5.8 million for Silicon Carbide Electronics Material Producibility Initiative, \$1.0 million for Quantitative Inspection Techniques for Assessing Aging Military Aircraft, and \$1.4 million for Body Armor Underarm and Side Protection with Smart Materials. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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Page-1 of 19	Exhibit R-2 (PE 0603112F)
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Exhibit R-2, RDT&E Bu	Exhibit R-2, RDT&E Budget Item Justification								
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Mate	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems							
(U) <b><u>B. Program Change Summary (\$ in Millions)</u></b>									
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>					
(U) Previous President's Budget	70.100	48.901	43.519	45.465					
(U) Current PBR/President's Budget	65.193	82.290	39.730	39.324					
(U) Total Adjustments	-4.907								
(U) Congressional Program Reductions									
Congressional Rescissions	0.023	-0.311							
Congressional Increases		33.000							
Reprogrammings	-3.429	0.700							
SBIR/STTR Transfer	-1.501								

#### (U) <u>Significant Program Changes:</u>

In FY 2007, Project 77SP, Advanced Space Materials, efforts transfer from PE 0603500F, Multidisciplinary Space Technology, Project 5032, Advanced Space Materials, in order to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

Under Development.

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L	Page-2 of 19	Exhibit R-2 (PE 0603112F)
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		Exhibit R-	2a, RDT&I	E Project	Justificatio	on				DATE	February	2007
	ET ACTIVITY dvanced Technology Developme	ent (ATD)			06031	IBER AND TITL 12F Advance on Systems		s for			ER AND TITLE Irdened Mat	erials
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 201		2013	Cost to	Total
	· · · ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimat		mate	Complete	
2100	Laser Hardened Materials	26.653	35.689	25.610	26.409	34.036	32.012	32.6		33.485	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0	0		
I	A. Mission Description and Budget This project develops and demonstrate perform required missions in threat en systems to ensure safety, survivability	es advanced m avironments. A , and operabili	aterials techno Advanced mate ity in threat en	erials technolo	-		demonstrated	l to enhanc	e protecti	on for A	Air Force sens	
(U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST/CONGRESSION/ technologies that enhance hardening f mission effectiveness of aerospace sy \$2.6 million in FY 2006 for Large Par Panel Sapphire Producibility.	AL ADD: Dev for sensors, av stems. Note: nel Sapphire F	velop and dem ionics, and con This effort inc producibility an	mponents to in cludes Congre nd \$1.2 millio	ncrease surviva essional Add fu on in FY 2007 :	ability and inding of for Large	<u>FY 20</u> 20.0		<u>FY 2007</u> 27.556		<u>FY 2008</u> 19.812	<u>FY 2009</u> 20.020
	In FY 2006: Developed a mid-wavele Evaluated solid state limiter materials damage phenomenologies for large for	having potent format charge c	tial for dual ba	nd operation. s (CCD).	Evaluated jar	nming and						
	In FY 2007: Mature hardening technological conditional statements of the statement of the s	Develop pro	tection strategi	ies for large fo	ormat CCDs.	-						
	In FY 2008: Demonstrate mature har Characterize and incorporate candidat protection strategies for large format	te dual band li										
(U)	In FY 2009: Transition mature harde Demonstrate performance of dual ban	ning materials	•••		e tactical syste	m.						
1	MAJOR THRUST/CONGRESSIONA technologies that enhance protection f perform required missions in a threat funding of \$1.0 million in FY 2007 fo	for Air Force a environment.	ircrews to ens Note: This ef	ure safety and fort includes	d to enable airc Congressional	crews to Add	6.6	52	8.133		5.798	6.389
(U)	In FY 2006: Developed and characte and optical power limiters. Develope In FY 2007: Demonstrate brassboard	rized an NVG d agile filter a	brassboard sy nd optical limi	stem using sta iter technolog	ate-of-the-art a ies.	gile filters						
Proje	ct 2100				Line Item No. 20 Page-3 of 19 <b>361</b>	)					Exhibit R-2a (P	PE 0603112F)

		Exhibit	R-2a, RD	C&E Projec	t Justifica	tion			DATE	DATE February 2007		
	GET ACTIVITY Advanced Technology Devel	lopment (ATD	)		0603	UMBER AND TI 3112F Advan Ipon System	ced Material			ECT NUMBER AND TITLE Laser Hardened Materials		
(U)	<b>B. Accomplishments/Planned</b> limiters. Characterize and inco Force applications.	-		limiter technol	ogies into devi	ces for Air	<u>FY 2</u>	006	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Validate performa configuration. Optimize agile f		•	-	*	s in a system						
(U)	In FY 2009: Transition advance configuration. Demonstrate ag	•			-	•						
(U)	Total Cost	-					26.	653	35.689	25.610	26.409	
(U)	C. Other Program Funding Su	ummary (\$ in N <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> FY 2007 Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete	Total Cos	
U)	Related Activities: PE 0602102F, Materials. PE 0602202F, Human											
	Effectiveness Applied Research.											
U)	PE 0603231F, Crew Systems and Personnel Protection											
(U)	Technology. PE 0603500F, Multi-Disciplinary Advanced											
	Development Space Technology.											
(U)	PE 0604706F, Life Support Systems.											
U)	This project has been coordinated through the											
	Tri-Service Laser Hardened Materials and Structures											
	Group and the Joint Service Agile Laser Eye Protection											
	Program.			F	R-1 Line Item No	. 20						
Pro	oject 2100				Page-4 of 19 <b>362</b>					Exhibit R-2a (I	PE 0603112	

Exhibit R-2a, RDT&E P	roject Justification	DATE February 2007
UDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 2100 Laser Hardened Materials
<ul> <li><b>C. Other Program Funding Summary (\$ in Millions)</b></li> <li><b>J.</b> This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li><b>D. Acquisition Strategy</b> Not Applicable.</li> </ul>		
Project 2100	R-1 Line Item No. 20 Page-5 of 19 363	Exhibit R-2a (PE 060311

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY Ivanced Technology Developme	ent (ATD)			06031	MBER AND TITL 12F Advanc on Systems	ed Materials	s for 31	OJECT NUMBE 53 Non-Des evelopment		pection
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
3153	Non-Destructive Inspection Development	Actual 13.287	Estimate 15.885	Estimate 3.772	Estimate 3.875	Estimate 4.389	Estimate 4.449	Estimate 4.542	Estimate 4.653	Complete Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
Aging Mainte (U) <u>4</u> T	Funds for the FY 2007 Congressiona Military Aircraft in the amount of \$1 enance, for execution. A. Mission Description and Budget This project develops and demonstrate causing conditions in weapon systems practices. This project provides techn cost-effectiveness at field and depot m	.1 million are Item Justifica es advanced no components a ology to satisf	in the process <u>tion</u> ondestructive i and materials. y Air Force re	of being mov nspection/eva NDI/E capab quirements to	aluation (NDI/ bilities greatly o extend the lif	<ul> <li>B112F, Advand</li> <li>E) technologie</li> <li>influence and/</li> <li>cetime of curre</li> </ul>	ced Materials es to monitor p for limit many ent systems thr	for Weapon S performance in design, manu ough increase	ystems, from ntegrity and to facturing, and d reliability and	PE 0702207F, o detect failure maintenance	, Depot
(U) 1 (U) 1 (U) 1 (U) 1 (U) 1	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop and den for cracks and other damage to extend In FY 2006: Demonstrated methods to welded) turbine engine components. fracture-critical gas turbine engine co In FY 2007: Transition methods to de turbine engine components. Transition engine components.	nonstrate adva I the total safe to detect and c Validated enhi- mponents. etect and chara on enhanced N	nced technolo, life of turbine haracterize da anced NDI/E a ncterize damag DI/E approach	engines. mage in repai approaches to ge in repaired hes to extend t	red (linear fric extend the life (linear frictior the life of supe	ction e of 1 welded) eralloy	<u>FY 20</u> 1.0	_	<u>Y 2007</u> 0.891	<u>FY 2008</u> 0.486	<u>FY 2009</u> 0.533
(U) 1 (U)	In FY 2008: Develop NDI/E approac components. In FY 2009: Validate NDI/E approac components.	hes to extend	the life of frac	ture-critical g	as turbine eng						
(U) ]	MAJOR THRUST: Develop and den low-observable (LO) systems to enha In FY 2006: Developed and demonst use in battle damage assessment and n In FY 2007: Transition a portable, m	nce affordabili rated a portabl repair of LO m	ty and ensure e, multifunction aterials and st	full performa onal, multipla ructures.	nce and surviv atform diagnos	tics tool for	0.6	24	0.315	0.266	0.292
Proje	ct 3153				Line Item No. 2 Page-6 of 19 364	0				Exhibit R-2a (P	E 0603112F)

	Exhibit R-2a, RDT&E Project Jus	stification		DATE	February	2007		
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Weapon Systems	I Materials for		OJECT NUMBER AND TITLE 53 Non-Destructive Inspection evelopment			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	damage assessment and repair of LO materials and structures.							
(U)	In FY 2008: Develop and demonstrate multiuse, multiplatform LO NDI/E hand to	ol that meets user						
	requirements.							
	In FY 2009: Transition multiuse, multiplatform LO NDI/E hand tool that meets us	er requirements.						
(U)		1. 1 1	0.005	0.210	1 (2)	1 (20)		
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advance	•	8.835	8.310	1.631	1.639		
	improved capabilities in materials corrosion, fatigue monitoring, and testing of agin	-						
	operations and maintenance costs. These technologies will contribute to full operative the aircraft fleet. Note: This effort includes Congressional Add funding of \$7.9 mi							
	(\$2.1 million for Assessing Aging Military Aircraft, \$4.8 million for Aging Militar							
	at National Institute for Aviation Research, and \$1.0 million for Non-Destructive T							
	Corrosion Detection) and \$7.0 million in FY 2007 (\$2.0 million for Aging Aircraft	U (						
	National Institute for Aviation Research, \$2.0 million for Assessing Aging of Milit							
	million for Inspection and Analysis Methods for Aging Military Aircraft, and \$1.0	-						
	Quantitative Inspection Techniques for Assessing Aging Military Aircraft).							
(U)	In FY 2006: Transitioned advanced electromagnetic techniques to detect cracks in	multiple layers to						
	meet aging aircraft life extension requirements. Identified and developed application	on-focused NDI/E						
	technologies to meet emerging inspection requirements for aging aircraft.							
(U)	In FY 2007: Demonstrate application-focused NDI/E technologies to meet emergin	ng inspection						
	requirements for aging aircraft.							
(U)	In FY 2008: Validate NDI/E technologies to meet emerging inspection requirement	nts for aging aircraft						
	and develop processes.							
(U)	In FY 2009: Transition application-focused NDI/E technologies to meet emerging	inspection						
	requirements for aging aircraft.							
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advance	d avetame status	2.786	3.381	1.389	1.411		
(0)	monitoring technologies to provide on-board and embedded sensing to gain continu	•	2.780	5.561	1.307	1.411		
	state of key subsystems. Note: This effort includes Congressional Add funding of							
	2006 (\$1.0 million for Materials Integrity Management Research for AF and \$1.0 r							
	Continuous Integrated Vehicle Monitoring System) and \$2.0 million in FY 2007 (\$							
	Materials Integrity Management Research for AF Systems and \$1.0 million for Con-							
		e Item No. 20						
Pro		e-7 of 19 365			Exhibit R-2a (I	PE 0603112F)		

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)		IBER AND TITLE			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Vehicle Health Monitoring System).					
(U)	In FY 2006: Developed sensors to monitor real-time health of high-temperatu					
	Developed smart sensor technologies for wiring health analysis. Developed for assessing the structural health of airframes.	ield-level inspection tools				
(U)	In FY 2007: Validate optimal sensing approaches for real-time health monito	ring of high-temperature				
	protection systems and characterize power scavenging and signal transmission	n issues. Validate smart				
	sensor technologies for wiring health analysis. Validate field-level inspection structural health of airframes.	tools for assessing the				
(U)	In FY 2008: Develop optimal sensing approaches for real-time health monito	ring of high-temperature				
	protection systems and characterize power scavenging and signal transmission					
	improved, smaller smart sensor technologies for wiring health analysis. Deve	lop data fusion to be used				
	with field-level inspection tools for assessing the structural health of airframes	8.				
(U)	In FY 2009: Develop optimal sensing approaches for real-time health monito	ring of high-temperature				
	protection systems and characterize power scavenging and signal transmission					
	sensor technologies for wiring health analysis. Transition total field-level insp	pection tool for assessing				
	the structural health of airframes.					
(U)			0.000	0.000	0.000	0.000
(U)	CONGRESSIONAL ADD: Low Observable Multi-Purpose Inspection Tool.		0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.	ulti Dumasa Inspection				
(U)	In FY 2007: Conduct Congressionally-directed effort for Low Observable Mu Tool.	uni-Purpose inspection				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
	CONGRESSIONAL ADD: Improved Stealth Aircraft Availability/Functiona	lity.	0.000	1.992	0.000	0.000
(U)	In FY 2006: Not Applicable.					
(U)	In FY 2007: Conduct Congressionally-directed effort for Improved Stealth A	ircraft				
	Availability/Functionality.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)	Total Cost		13.287	15.885	3.772	3.875
1	R-	-1 Line Item No. 20				
		Page-8 of 19			Exhibit R-2a (F	

	Exhibi	t R-2a, RD	F&E Projec	t Justifica	tion				February 2007
BUDGET ACTIVITY 03 Advanced Technology Deve	elopment (ATD	)		0603	UMBER AND TI 3112F Advan Ipon System	ced Material	s for	PROJECT NUMBE 3153 Non-Dest Development	R AND TITLE ructive Inspection
<ul> <li>(U) <u>C. Other Program Funding S</u></li> <li>(U) Related Activities:</li> <li>(U) PE 0602102F, Materials.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>			FY 2008 Estimate				FY 2012 Estimat	Development           2         FY 2013	Cost to Complete
Project 3153				R-1 Line Item No Page-9 of 19 367					Exhibit R-2a (PE 0603112F)

BLOGET ACTIVITY       Image: Constraint of the second			Exhibit R-	2a, RDT&E	Project	Justificatio	on			DATE	February 2	2007
Cost (S in Multions)         Actual         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Estimate         Complete           3946         Materials Transition         19.163         14.755         3.791         4.2276         4.265         4.354         4.461         Cominuing         TBD           Quantity of RDT&EK Articles         0         <			ent (ATD)			06031 <sup>-</sup>	12F Advanc	ed Materials				
3946       Materials Transition       19.163       14.755       3.742       3.791       4.276       4.265       4.354       4.461       Continuing       TBD         Quantity of RDT&E Articles       0		Cost (\$ in Millions)										Total
(U)       A.Mission Description and Budget Item Justification         This project develops and demonstrates advanced materials and processing technologies for fielded and planned Air Force weapon, airframe, and proquision applications. Advanced materials and processes that have matured beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. These design and scale-up data improve the overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development.         (U)       M.Accomplishments/Planned Program (S in Millions)       FY 2006       FY 2007       FY 2008       FY 2009         (U)       MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, and overall affordability of air vehicles. Note: This effort includes Congressional Add funding of \$13.9 million in FY 2006 (S11.2 million for Reduced Composite Manufacturing Costs Through the Application of Advanced Textile Technology, S5.0 million for Metals Affordability initiative, \$1.5 million for Steaht RAM Coatings, and \$1.7 million for Body Armor and Fragmentation Protection) and \$2.3 million in FY 2007 (FM Metals Affordability Initiative.       FY 2006       FY 2007       FY 2008       FY 2008         (U)       In FY 2006 (S1.2 million for Steaht RAM Coatings, and \$1.7 million for Advanced enterials and processes for Unmance Aerial Vehicles (UAVs), \$1.0 million for Metals Affordability Initiative.       FY 2008       FY 2007       FY 2008       FY 2008       FY 2008	394	6 Materials Transition						1		1	· · · · · · · · · · · · · · · · · · ·	TBD
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 mature beyond applied research are characterized, critical data are collected, and critical evaluations in the proposed operating environment are performed. These design and scale-up data improve the overall affordability of promising materials and processing technologies, providing needed initial incentives for their industrial development.         (U)       MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced materials and processing technologies for air vehicles and subsystems to enhance the lift, propulsion, low-observable performance, and overall affordability of air vehicles. Note: This effort includes Congressional Add funding of \$139 million in FY 2006 (L12 million for Reduced Composite Manufacturing Costs Through the Application of Advanced Textile Technology, \$5.0 million for Metals Affordability Initiative, \$1.5 million for Transparent Conductive Polymer Technology Development, \$1.0 million for Advanced Composite Processes for Unmannel Aerial Vehicles (LVA)s, \$1.0 million for Advanced Composite Processes for Unmannel Aerial Vehicles (LVA)s, \$1.0 million for Advanced Composite Processes for Conductive Polymer Technology Development, \$1.0 million for Advanced Composite Processes for Unmannel Aerial Vehicles (LVA)s, \$1.0 million for Advanced Interials admage predictive approaches for crigine health determination and life extension capability. Transitioned reliable life extension capability for turbine engine applications and initiate scale-up of fabrication processes to increase the capabilities of coated conductors for utra-high power generation for airborned ricet duraterials amprovement methods. Investigated primer/sealer material for improved duratifilas propertises for a minicine transition for theorengy negators. S		Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
(U)       MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced materials and       16.994       5.665       3.523       2.666         performance, and overall affordability of air vehicles. Note: This effort includes Congressional Add       funding of \$13.9 million in FY 2006 (\$1.2 million for Reduced Composite Manufacturing Costs       Through the Application of Advanced Textile Technology, \$5.0 million for Metals Affordability       initiative, \$1.5 million for Transparent Conductive Polymer Technology Development, \$1.0 million for       Ultra-Lightweight Composites, \$2.5 million for Steahth RAM Coatings, and \$1.7 million for       Ultra-Lightweight Composites, \$2.5 million in FY 2007 for Metals Affordability Initiative.       V		This project develops and demonstrate applications. Advanced materials and the proposed operating environment a technologies, providing needed initial	es advanced m processes that re performed. incentives for	aterials and pr t have matured These design their industria	l beyond appl and scale-up	ied research ar data improve t	re characterize	ed, critical data ordability of p	a are collected romising mat	l, and critical e erials and proc	evaluations in cessing	EV 2000
life extension capability. Transitioned reliable life extension capability for turbine engine rotors. Developed and demonstrated high temperature composites for turbine engine applications and initiate transition of these materials to relevant platforms. Scaled-up advanced materials and initiated scale-up of fabrication processes to increase the capabilities of coated conductors for ultra-lightweight, ultra-high power generation for airborne directed energy weapons. Evaluated materials properties for a mid-infrared laser source enabling aircraft countermeasures and integrated best material improvement methods. Investigated primer/sealer material for improved durability of LO materials in fluid contaminated areas on emerging fighter aircraft. Developed flexible/lightweight conductive gap filler for LO aircraft. Developed processes for removal of radar absorbing material on large aircraft areas. Developed hot-melt conductive fastener fill. Improved processing of room-temperature-storable radar absorbing structure repair materials. Developed non-destructive evaluation tool for limited access areas on aircraft. Project 3946 Project 3946 R-1 Line Item No. 20 Project 0946 Exhibit R-2a (PE 0603112F)	(U)	MAJOR THRUST/CONGRESSIONA processing technologies for air vehicle performance, and overall affordability funding of \$13.9 million in FY 2006 ( Through the Application of Advanced Initiative, \$1.5 million for Transparen Advanced Composite Processes for U Ultra-Lightweight Composites, \$2.5 r Armor and Fragmentation Protection)	AL ADD: Deves and subsyster of air vehicles (\$1.2 million f d Textile Technic the Conductive of Immanned Aeric million for Stea of and \$2.3 mill	velop and dem ems to enhance s. Note: This or Reduced Co nology, \$5.0 n Polymer Techn al Vehicles (U alth RAM Coa ion in FY 200	e the lift, prop effort include omposite Mar hillion for Me hology Develo JAVs), \$1.0 n tings, and \$1. 7 for Metals A	pulsion, low-of es Congression nufacturing Co tals Affordabil opment, \$1.0 m nillion for .7 million for H Affordability II	bservable al Add sts lity nillion for Body nitiative.					
Project 3946 Page-10 of 19 Exhibit R-2a (PE 0603112F)		life extension capability. Transitioned Developed and demonstrated high ten transition of these materials to relevar of fabrication processes to increase th power generation for airborne directed mid-infrared laser source enabling air methods. Investigated primer/sealer r contaminated areas on emerging fight for LO aircraft. Developed processes Developed hot-melt conductive faster absorbing structure repair materials.	d reliable life e nperature com nt platforms. S e capabilities o d energy weap craft counterm naterial for im er aircraft. De for removal o ner fill. Impro	extension capa posites for turl Scaled-up adva of coated cond ons. Evaluate neasures and in proved durabi eveloped flexil f radar absorb ved processing	bility for turb pine engine ap inced material uctors for ultr d materials pr itegrated best lity of LO ma ple/lightweigh ing material of g of room-tem valuation too	ine engine roto pplications and ls and initiated ra-lightweight, roperties for a material impro- terials in fluid nt conductive g on large aircraf aperature-stora l for limited ac	ors. I initiate I scale-up , ultra-high ovement gap filler it areas. ble radar ccess areas					
	Pro	oject 3946				Page-10 of 19	•				Exhibit R-2a (P	E 0603112F)

	Exhibit R-2a, RDT&E Project Jus	tification		DATE February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials fo Weapon Systems		TNUMBER AND TITLE	
(U)		<u>FY 2006</u>	<u>FY 200</u>	<u>7 FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Develop materials-damage predictive approaches for engine health det extension capability. Complete transition of high-temperature organic matrix comp engine components. Characterize advanced materials and materials process capabil processing techniques and assess process repeatability for power generation materia directed energy weapons. Demonstrate functionality of integrated methods for a mi source enabling aircraft countermeasures. Demonstrate flexible/lightweight conduct Evaluate processes for removal of radar absorbing material on large aircraft areas. I primer/sealer material for improved durability of LO materials in fluid contaminated fighter aircraft. Evaluate improved processing of room-temperature-storable radar a repair materials. Demonstrate nondestructive evaluation tool for limited access area In FY 2008: Validate materials-damage predictive approaches for engine health det extension capability. Transition advanced materials and materials process capabilit component-level demonstrations of power generation materials for airborne directed Transition materials and processing concepts for component-level demonstrations o enabling mid-IR laser output with energy sufficient for enabling new aircraft self-pr Transition flexible/lightweight conductive gap filler. Validate advanced materials a technologies for transition to fielded and planned Air Force weapon, airframe, and p applications as well as support systems including Air Force Material Command (AF	osites for turbine ities for scaled-up ls for airborne d-infrared laser tive gap filler. Demonstrate l areas on emerging ubsorbing structure as on aircraft. ermination and life es for l energy weapons. f new material for otection schemes. nd processing propulsion			
(U)	infrastructure. In FY 2009: Validate materials-damage predictive approaches for engine health det extension capability. Transition advanced materials and processing technologies to Air Force weapon, airframe, and propulsion applications as well as support systems center infrastructure.	fielded and planned			
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced processing technologies to enhance the sustainability of Air Force aerospace system operations and maintenance costs and ensuring the full operability and safety of syst Note: This effort includes Congressional Add funding of \$2.0 million in FY 2006 (\$ Coated Field Repair and \$1.0 million for Room Temperature Nanocrystalline Diamed De-Icing) and \$1.0 million in FY 2007 for Coated Field Repair.	s by lowering tems and personnel. 61.0 million for ond Coating for	1.519	9 0.219	1.125
		Item No. 20			
Pro		-11 of 19 369		Exhibit R-2a (	PE 0603112F)

	Exhibit R-2a, RDT&	E Projec	t Justifica	tion			DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)		0603	JMBER AND TIT 112F Advan pon System	ced Material		ROJECT NUMB	ER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>				<u>FY 20</u>	<u>)06</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U)	emerging materials and processes for sustainment of Air Force sy In FY 2007: Develop test methodologies and evaluation techniq materials and processes for sustainment of Air Force systems.		tate transition of	of emerging					
(U)	In FY 2008: Identify and prioritize critical issues that are prever and processes for sustainment of Air Force systems.	ting transiti	on of emerging	materials					
(U)	In FY 2009: Develop test methodologies and evaluation techniq materials and processes for sustainment of Air Force systems.	ues to facilit	tate transition of	of emerging					
(U)									
(U)	CONGRESSIONAL ADD: Advanced Power Technology: Silice	on Carbide I	Power, Bipolar	Junction	0.0	000	1.793	0.000	0.000
(U)	Transistors. In FY 2006: Not Applicable.								
(U)	In FY 2007: Conduct Congressionally-directed effort for Advan	ced Power 7	Fechnology: Si	licon Carbide					
an	Power, Bipolar Junction Transistors. In FY 2008: Not Applicable.								
(U)	In FY 2009: Not Applicable.								
(U)									
(U)	CONGRESSIONAL ADD: Silicon Carbide Electronics Materia	l Producibil	ity Initiative.		0.0	000	5.778	0.000	0.000
(U)	In FY 2006: Not Applicable.								
(U)	In FY 2007: Conduct Congressionally-directed effort for Silicor Producibility Initiative.	Carbide El	ectronics Mate	rial					
	In FY 2008: Not Applicable.								
(U)	In FY 2009: Not Applicable.				10	1.62	14755	2 7 4 2	2 701
(U)	Total Cost				19.1	103	14.755	3.742	3.791
(U)	<u>C. Other Program Funding Summary (\$ in Millions)</u>								
	<u>FY 2006</u> <u>FY 2007</u> <u>Actual</u> <u>Estimate</u>	FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	TOTALCOST
` ´	Related Activities:								
	PE 0602102F, Materials.								
(U)	PE 0603203F, Advanced								
an	Aerospace Sensors. PE 0603211F, Aerospace								
(0)	r E 00032111, Actospace		R-1 Line Item No	20					
Pro	ject 3946	г	Page-12 of 19					Exhibit R-2a (F	PE 0603112F)
			370						

<ul> <li>Weapon Sys</li> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Technology Dev/Demo.</li> <li>(U) PE 0603216F, Aerospace Propulsion and Power Technology.</li> <li>(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.</li> <li>(U) This project has been</li> </ul>	Ivanced Materials for 3	February 2007 ROJECT NUMBER AND TITLE 946 Materials Transition
03 Advanced Technology Development (ATD)       0603112F Advanced Weapon System         (U)       C. Other Program Funding Summary (\$ in Millions)         Technology Dev/Demo.       Technology Dev/Demo.         (U)       PE 0603216F, Aerospace         Propulsion and Power       Technology.         (U)       PE 0603500F,         Multi-Disciplinary Advanced         Development Space         Technology.         (U)         (U)         PT 0603500F,         Multi-Disciplinary Advanced         Development Space         Technology.         (U)         This project has been	Ivanced Materials for 3	
<ul> <li>Technology Dev/Demo.</li> <li>(U) PE 0603216F, Aerospace Propulsion and Power Technology.</li> <li>(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.</li> <li>(U) This project has been</li> </ul>		
<ul> <li>coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>		
R-1 Line Item No. 20 Project 3946 Page-13 of 19		Exhibit R-2a (PE 0603112F)
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	Exhibit R-2	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
BUDGET ACTIVITY 03 Advanced Technology Developm	ent (ATD)			06031	IBER AND TITL 12F Advanc on Systems	ed Materials	for 49	OJECT NUMBE 18 Deployed monstratio	l Air Base	
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4918 Deployed Air Base Demonstrations	6.090	10.864	2.216	2.274	2.581	2.625	2.679	2.746	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
(U) <u>A. Mission Description and Budget</u> This project develops and demonstrate sustainment costs, and improve protect developed and demonstrated to provide operations.	es advanced, ra ction and surviv	pidly deploya ability of dep	loyed Air Exp	peditionary Fo	orce (AEF) wa	urfighters. Aff	ordable, effici	ent technolog	ies are	
<ul> <li>(U) <u>B. Accomplishments/Planned Prog</u></li> <li>(U) MAJOR THRUST/CONGRESSION airbase infrastructure technologies the sustainment costs in support of AEF of of \$1.7 million in FY 2006 for Hydro Oxidation (HTO) for Alaska.</li> </ul>	AL ADD: Dem at reduce airlift operations. Not	onstrate and and manpowe te: This effort	er requiremen includes Con	its, setup times igressional Ad	s, and d funding	<u>FY 20</u> 2.6		<u>¥ 2007</u> 4.436	<u>FY 2008</u> 0.902	<u>FY 2009</u> 0.945
(U) In FY 2006: Demonstrated a 10 kW performance. Demonstrated packed I both proton exchange membrane fuel integrated shelter power/heating, ven solar, and heat pump technologies int and air conditioning requirements for deflection technology and improved o airfield assessment and rapid repair.	bed fuel treatme cell and solid of tilation, and air to a highly effic individual depl	ent technology oxide fuel cell conditioning ient compact loyable shelte	y to remove su stacks. Deve concepts that system that ca rs. Develope	ulfur and integ eloped advance will integrate an provide tota d continuous l	rate with ed fuel cell, al energy oad					
(U) In FY 2007: Demonstrate a 10 kW fu performance. Demonstrate packed be shelter power/heating, ventilation, an technology and improved crater/spall assessment and rapid repair.	ed fuel treatmer d air conditioni	nt technology.	Demonstrate Develop conti	e advanced int inuous load de	egrated flection					
(U) In FY 2008: Develop transition plan Characterize catalytic and surface che and demonstrate continuous load defl	emistry technolo	ogies for appl	ication to bar	e base utilities						
				Line Item No. 2						

	Exhibit R-2a, RDT&E Project Ju	stification		DATI	February	2007
	GET ACTIVITY dvanced Technology Development (ATD)	PROJECT NUM 4918 Deplo Demonstrat				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	In FY 2009: Develop best methods for integration of advanced power generation Characterize and ensure processes for innovative technologies. Begin development and demonstration of miniaturized airfield assessment techno					
	MAJOR THRUST/CONGRESSIONAL ADD: Demonstrate and transition afford technologies to provide force protection and fire fighting capability for deployed This effort includes Congressional Add funding of \$2.6 million in FY 2006 for X Detection System.	AEF operations. Note:	3.451	1.148	1.314	1.329
(U)	In FY 2006: Demonstrated improved blast suppression technologies and fragmer materials for new and existing structures. Initiated demonstration of explosive sto technologies. Demonstrated improved fire fighter safety technologies. Develope filtration technologies for expeditionary structures.	brage protective				
	In FY 2007: Demonstrate improved blast suppression technologies and fragment materials for new and existing structures and for explosive storage facilities. Cor improved fire fighter safety technologies and transition technology to operational integrated crash/rescue fire fighting demonstration. Integrate air filtration techno demonstration for expeditionary structures.	nplete demonstration of units. Initiate an				
	In FY 2008: Develop and analyze effectiveness of improved blast suppression te fragmentation protection materials for new and existing structures. Demonstrate technologies. Transition technical orders and construction standards supporting f technologies for fire fighter safety technologies. Evaluate ultrahigh pressure, star innovative technologies with test bed vehicles. Develop air filtration and model/e filtration effectiveness for expeditionary structures.	explosives detection ire suppression idoff nozzles, and other				
	In FY 2009: Validate and fabricate improved blast suppression technologies and protection materials for new and existing structures. Demonstrate and validate extechnologies. Evaluate and characterize improved fire fighter safety technologies technology to operational units. Characterize and analyze/evaluate ultrahigh press and other innovative technologies with test bed vehicles. Characterize air filtration reactive filtration effectiveness for expeditionary structures.	plosives detection and transition sure, standoff nozzles,				
(U)						
(U)	CONGRESSIONAL ADD: Blast Resistant Barriers and Structural Design for He	omeland Defense.	0.000	1.295	0.000	0.000
Proi		ne Item No. 20 ge-15 of 19			Exhibit R-2a (F	PE 0603112E)

Exhibit R-2a, RDT&E Project J	ustificat	ion			DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	0603 <sup>-</sup>	MBER AND TIT 112F Advan oon Systems	ced Materials	s for 4	PROJECT NUMB 1918 Deploye Demonstratio	ER AND TITLE d Air Base	2007
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>			<u>FY 20</u>	)06	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2006: Not Applicable.							
(U) In FY 2007: Conduct Congressionally-directed effort for Blast Resistant Barrier	rs and Struct	ural Design					
for Homeland Defense.							
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
			0.0		1 205	0.000	0.000
(U) CONGRESSIONAL ADD: Body Armor Underarm and Side Protection with Sr	nart Materia	lls.	0.0	000	1.395	0.000	0.000
(U) In FY 2006: Not Applicable.							
(U) In FY 2007: Conduct Congressionally-directed effort for Body Armor Underarr with Smart Materials.	n and Side F	rotection					
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
(U) (U)							
(U) CONGRESSIONAL ADD: Combined Agent Fire Fighting System.			0.0	000	0.996	0.000	0.000
(U) In FY 2006: Not Applicable.			0.0	100	0.990	0.000	0.000
(U) In FY 2007: Conduct Congressionally-directed effort for Combined Agent Fire	Fighting Sv	stem.					
(U) In FY 2008: Not Applicable.	88 -> 5						
(U) In FY 2009: Not Applicable.							
(U)							
(U) CONGRESSIONAL ADD: Encapsulated Ballistic Protection System.			0.0	000	1.594	0.000	0.000
(U) In FY 2006: Not Applicable.							
(U) In FY 2007: Conduct Congressionally-directed effort for Encapsulated Ballistic	Protection S	System.					
(U) In FY 2008: Not Applicable.							
(U) In FY 2009: Not Applicable.							
(U) Total Cost			6.0	)90	10.864	2.216	2.274
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>							
	FY 2009	FY 2010	FY 2011	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	
	Estimate	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>		<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
(U) Related Activities:	Loumate	Esumate	Esumate	Estimate	Estimate	Complete	
(U) PE 0602102F, Materials.							
(U) PE 0603287F, Physical							
	_ine Item No.	20					
	age-16 of 19					Exhibit R-2a (F	PE 0603112F)
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Exhibit R-2a, RDT&E Project Justification February 200									
BUDGET ACTIVITY D3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	4918 D	T NUMBER AND TITLE eployed Air Base strations						
<ul> <li>U) C. Other Program Funding Summary (\$ in Millions) Security Equipment.</li> <li>U) PE 0604617F, Agile Combat Support.</li> <li>U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>U) D. Acquisition Strategy Not Applicable.</li> </ul>									
Project 4918	R-1 Line Item No. 20 Page-17 of 19		Exhibit R-2a (PE 0603112						

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
		ent (ATD)			06031 <sup>-</sup>	12F Advanc	ed Materials				aterials
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011			Cost to	Total
		Actual								-	
77SP	Disk         EXhibit K-28, RU14E Project Justification         February 2007           3 Advanced Technology Development (ATD)         PROJECT NUMBER AND TITLE 005112F Advanced Materials for Weapon Systems         PROJECT NUMBER AND TITLE 005112F Advanced Materials for Veapon Systems         PROJECT NUMBER AND TITLE 005112F Advanced Materials for Veapon Systems         PROJECT NUMBER AND TITLE 005112F Advanced Materials of VE 2010 PY 2010         FY 2011         FY 2012         FY 2013         FY 2013         FY 2013         System Strain Estimate         Estimate         Complete T           29P         Advanced Space Materials         0.00         5.007         4.2030         2.975         3.370         3.420         3.491         3.579         comming to commission           Quantity of RDT&B Arricles         0.00         5.007         4.2030         2.975         3.370         3.420         3.491         3.579         commission           Outer to more effectively manage and provide ovaright of the efforts.         N.         Mission Description and Budget Hem Justification         This project develops and demonstrate materials acpability in the relative environment. Sub-scale components and nonstructural materials components are developed and demonstrate develop and demonstrate materials compolicy in proves the affordability, reliability, survivability, and operational performance of current and future space systems.         FY 2000         FY 2007         FY 2008         FY 2000         FY 2008         FY 200		TBD								
Nota			•	*	*	÷		nology De			  atomiolo
	-	-			2 0005500F, M	rununscipinia	Ty space Tech	lilology, Flo	Ject 5052, Auv	anceu space w	lateriais,
] s c e s	This project develops and demonstrate caled up to the appropriate level to de leveloped and demonstrated to valida engineering and system design decision ensors from a variety of laser threats.	es materials an emonstrate ma te expected ma ons. Laser har	d processing t terials capabil aterials charac dened materia	ity in the relate teristics. Crite ls technologie	tive environme ical data on bo es are develope	ent. Sub-scale oth structural <i>a</i> ed, demonstrat	e components and nonstructu ted, and transit	and nonstru ral materia tioned for t	ictural material ls is developed a he broadband pr	components ar and provided for otection of spa	e or
(U) 1 1 (U) 1 (U) 1 1 1	MAJOR THRUST: Develop and den revolutionary improvements in the pe and weapons. In FY 2006: Not Applicable. In FY 2007: Develop advanced mate protection systems for leading edge ap vehicle concepts. For management of materials, including organic matrix co	nonstrate adva rformance of a rials approache pplications on f the thermal a omposites, cera	nced materials air-breathing a es to provide of high-speed, re nd structural h amics, metals,	nd rocket-bas lurable, maint susable launch oads, combina carbon foams	ed aerospace v tainable high-to n, and future re ations of candi s, aerogels, hea	vehicles emperature centry date at pipes,					<u>FY 2009</u> 1.439
(U) ]	<ul> <li>oxidizing environment. Develop rocket propulsion materials for liquid and solid rocket engine components and validate performance in scaled component demonstrations.</li> <li>(U) In FY 2008: Refine developed materials formulations and approaches for thermal protection systems and aeroshells that provide solutions for cost-effective scale-up, fabrication, and integration techniques. Validate performance of high temperature composites on integrated cryogenic tanks and hypersonic structures, demonstrating low cost component fabrication and scale-up of design and process</li> </ul>										
(U) I	in FY 2009: Utilizing newly develop	ed materials a	pproaches, fab	ricate therma	l protection sy	stem					
Proje	ct 77SP				Line Item No. 20 Page-18 of 19 <b>376</b>	0				Exhibit R-2a (F	PE 0603112F)

Exhibit R-2a, RDT&E Project J	lustification		DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TI 0603112F Advan Weapon System	ced Materials for	PROJECT NUMI 77SP Advan		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> sub-components for high temperature testing. Develop a sub-component cryoge conduct studies to demonstrate the integration of ceramic, metallic, and carbon- protection system components.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop and demonstrate advanced materials technologies for space systems. Note: In FY 2005, efforts in this major thrust were delayed higher Air Force priorities.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Optimize and validate limiter and filter technology for protection a power lasers. Analyze laser phenomenology for intrinsic hardening solutions to susceptibility in electro-optical sensors.</li> <li>(U) In FY 2009: Fabricate and demonstrate limiter and filter technology for protect: Investigate impact of inserting state-of-the-art filters and optical power limiters configuration</li> </ul>	until FY 2008 due to against low and high jamming and damage ion of space systems.	0.000	0.000	2.361	1.536
configuration. (U) Total Cost		0.000	5.097	4.390	2.975
	FY 2009 FY 2010 Estimate Estimate	<u>FY 2011 FY 2</u> Estimate Esti	2012 FY 2013 imate Estimate		Total Cost
	Line Item No. 20 Page-19 of 19 377			Exhibit R-2a (	PE 0603112F)

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#### PE NUMBER: 0603203F PE TITLE: Advanced Aerospace Sensors

	Ex	hibit R-2,	RDT&E B	udget Item	n Justifica	tion			DATE	February 2	2007	
	DGET ACTIVITY     PE NUMBER AND TITLE       Advanced Technology Development (ATD)     0603203F Advanced Aerospace Sensors											
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
	Total Program Element (PE) Cost	38.471	58.228	55.549	52.840	60.141	56.918	54.172	55.294	Continuing	TBD	
665A	Advanced Aerospace Sensors Technology	12.573	16.428	14.800	13.020	23.074	20.184	16.707	16.570	Continuing	TBD	
69DF	Target Attack and Recognition Technology	25.898	29.659	28.435	29.462	29.002	28.546	29.110	30.187	Continuing	TBD	
88SP	Advanced Space Sensors	0.000	12.141	12.314	10.358	8.065	8.188	8.355	8.537	Continuing	TBD	

Note: In FY 2006, efforts in Project 5019 transferred to Project 665A within this PE. In FY 2007, Project 88SP, Advanced Space Sensors, efforts transferred from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts.

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

Divided into three broad project areas, this program develops technologies to enable the continued superiority of sensors from aerospace platforms. The first project develops and demonstrates advanced technologies for electro-optical (EO) sensors, radar sensors and electronic counter-countermeasures (ECCM), and components and algorithms. The second project develops and demonstrates radio frequency (RF) and EO sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. The third project develops and demonstrates space sensor technologies including RF sensors; intelligence, surveillance, and reconnaissance (ISR) sensors; EO sensors; laser warning sensors; targeting and attack radar sensors; and ECCM and communications. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Note: In FY 2007, Congress added \$1.3 million for National Operational Radar Signature Production and Research Capability (Combat Identification Signature Center); \$1.0 million for TACNODES; and \$1.0 million for Precision Image Tracking and Registration Program. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

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Exhibit R-2, RDT&E Bu	dget Item Justification		DATE Februa	DATE February 2007		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aero	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors				
(U) <b><u>B. Program Change Summary (\$ in Millions)</u></b>						
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) Previous President's Budget	39.782	55.150	54.992	58.971		
(U) Current PBR/President's Budget	38.471	58.228	55.549	52.840		
(U) Total Adjustments	-1.311					
(U) Congressional Program Reductions		-0.002				
Congressional Rescissions	-0.001	-2.200				
Congressional Increases		3.300				
Reprogrammings	-0.416					
SBIR/STTR Transfer	-0.894					

#### (U) <u>Significant Program Changes:</u>

In FY 2007, Project 88SP, Advanced Space Sensors, efforts transferred from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5034, Advanced Space Sensors, in order to more effectively manage and provide oversight of the efforts.

C. Performance Metrics

Under Development.

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Page-2 of 22	Exhibit R-2 (PE 0603203F)
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		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY Ivanced Technology Developm	ent (ATD)				MBER AND TITL 03F Advanc ors		ce 66	OJECT NUMBE 5A Advance chnology		e Sensors
	Cost (\$ in Millions)	Actual Estimate Estimate Estimate Estimate Estimate Estimate Com					Cost to Complete	Total			
665A	Advanced Aerospace Sensors Technology	12.573	16.428	14.800	13.020	23.074	20.184	16.707	16.570	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
Note:	In FY 2006, efforts in Project 5019	within this PE (	transferred to	this project.							
T r a t	A. Mission Description and Budget This project develops and demonstrate adar applications in both manned and perospace platforms with the capabilities ime-critical targets in adverse clutter Desired warfighting capabilities inclu	es aerospace se l unmanned pla ty to precisely and jamming e	ensor and proc atforms, includ detect, track, a environments.	ding electro-o and target both Project activ	ptical (EO) set h airborne (con rities include d	nsors and elec nventional and eveloping mu	tronic counter l low radar cro lti-function rad	-countermeas oss section) ar	ures for radars	. It provides ed, high-value	
(U) ]	<b>B. Accomplishments/Planned Prog</b>	ram (\$ in Mill	<u>ions)</u>				<u>FY 20</u>	0 <u>6</u> F	Y 2007	FY 2008	<u>FY 2009</u>
(U) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Desired warfighting capabilities include the ability to detect concealed targets in difficult background conditions.         U) <b>B. Accomplishments/Planned Program (\$ in Millions)</b> FY 2006       FY 2007       FY 2         U)       MAJOR THRUST: Develop integrated EO sensor technology to search, detect, locate, and identify air       2.454       3.583       4.         and ground targets at ranges significantly longer than currently achievable, including targets that are camouflaged, low-observable, or employ other means of deception.       In FY 2006: Completed multi-spectral passive cueing demonstration in an airborne environment. Developed a multi-function active/passive EO/infrared (IR) sensor demonstration system to detect, locate, and identify difficult targets in both obscured and urban environments for ISR applications. Analyzed advanced passive and multi-function active sensing methods to optimize detection and identification of difficult targets. Performed preliminary design for multi-mode unmanned aerial vehicle based sensor, including platform integration plans. Designed and fabricated optical components for long wave infrared spectral/polarimetric imager for high altitude sensor. Conducted in-house target and background characterization studies with modified long wave infrared imaging spectrometer.							4.975	4.654		
	Conduct flight test to demonstrate tar ct 665A	6		R-1	Line Item No. 2 Page-3 of 22					Exhibit R-2a (P	E 0603203F)
					381						

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advance Sensors			IBER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> of an engineering model for an improved 3D-laser radar (LADAR) system wi resolution capability to support automated/assisted target recognition of obscu		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)		/passive EO/IR oscured and urban esolution, 3D-LADAR for or low false alarm rate ion techniques. Perform for enhanced low contrast				
(U)		oscured and urban nigh-resolution, ectral imaging for low false discrimination techniques. for enhanced low contrast				
(U) (U)	MAJOR THRUST: Develop EO sensor technologies to detect and locate can	outlaged and concealed	1.602	4.474	0.000	0.000
(0)	targets for aerospace ISR applications. Note: Efforts complete in FY 2007.	lounaged and conceated	1.002	1.171	0.000	0.000
(U)	In FY 2006: Extended performance of a demonstration sensor for high altitude to incorporate an emissive spectral sensing capability. Fabricated, laboratory a emissive spectrometer components.					
(U)						
(U)	In FY 2008: Not Applicable.					
· · ·	In FY 2009: Not Applicable.					
	MAJOR THRUST: Develop technologies to maximize positional accuracy, t	iming accuracy, and	1.740	2.080	2.092	1.988
	ject 665A	-1 Line Item No. 21 Page-4 of 22				PE 0603203F)

	Exhibit R-2a, RDT&E Proje	ect Justification		DATE	February	2007	
	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Sensors	d Aerospace		MBER AND TITLE Inced Aerospace Sensors IV		
	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	exploitation techniques to improve offensive and defensive combat capabil In FY 2006: Developed critical experiments using virtual flight test simular reference technologies for net centric warfare. Designed follow-on distribu- timing (PNT) advanced technology demonstration to optimize time-sensiti awareness, and persistent ISR capabilities. Improved report, track, and im	ation to characterize assured uted position, navigation, and ve targeting, battlespace					
(U)	technologies for multi-intelligence sensor data. In FY 2007: Demonstrate critical experiments to characterize assured refe centric warfare. Develop sensor phenomenology-based georegistration for	rence technologies for net					
(U)	tests of multi-intelligence georegistration. In FY 2008: Develop worldwide ultra-accurate positioning system technol sensitive targeting, battlespace awareness, and persistent ISR capabilities. multi-sensor phenomenology-based georegistration for imagery and perfor	Continue to develop					
(U)	multi-intelligence georegistration. In FY 2009: Demonstrate worldwide ultra-accurate positioning system tec sensitive targeting, battlespace awareness, and persistent ISR capabilities. multi-sensor phenomenology-based georegistration for imagery and perfor multi-intelligence georegistration.	Continue to develop					
(U)	man mongenee georegistation						
(U)	MAJOR THRUST: Develop, test, evaluate, and demonstrate lightweight, frequency (RF) sensors to detect, track, and target high-value, time-critical detect through either stealth or concealment and enable persistent ISR from (UAV). Develop and validate long-range ISR sensor technologies and tech track of advanced air and ground targets. Advanced target characteristics in cross section, concealment capabilities, or electronic counter-countermease emphasis in this thrust in FY 2008 and FY 2009 is due to the increased for (HRR).	targets that are difficult to n an unmanned aerial vehicle hniques for the detection and nclude targets with low radar ures. Note: The growing cus on high resolution radar	6.278	3.528	6.467	5.398	
	In FY 2006: Flight tested a lightweight, low profile multi-function active of on an airborne test bed to demonstrate integrated radar technology capabilitiest and predicted system performance on target platforms using advanced Demonstrated accurate, real-time detection and location with enhanced mit Demonstrated RF sensors for an integrated EO/RF sensor suite for UAVs of	ity. Analyzed data from flight computational techniques. llimeter wave sensor.					
	ect 665A	R-1 Line Item No. 21					

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007	
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aero Sensors	ospace		NUMBER AND TITLE vanced Aerospace Sensors ogy		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>	<u> </u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	power constraints, to enable single platform persistent ISR capability compatil systems architecture. Constructed a multi-intelligence sensor suite ground test airborne moving platform. Performed risk reduction efforts for airborne imple radar systems engineering support fostering the transition of developed enablin concepts to weapon systems and ISR assets. Developed integrated electronic s (ESM)/passive radar concept for enhanced target detection and tracking. Devel analysis/mitigation of passive multistatic, multi-intelligence sensing. In FY 2007: Continue demonstration of the RF sensors of an integrated EO/F with severe size, weight, and power constraints, to enable single platform pers compatible with a system of systems architecture. Develop highly integrated r technologies for improved functionality and greatly reduced size, weight, and experiments with the ground test bed providing input into a design for an airbor experiment. Continue radar systems engineering support fostering the transitie technologies and concepts to weapon systems and ISR assets. Develop progra analysis/mitigation of passive multistatic, multi-intelligence sensing.	ble with a system of t bed to emulate an ementations. Conducted ng technologies and support measures eloped program for threat RF sensor suite for UAVs istent ISR capability receiver-aperture power. Continue orne multi-intelligence on of developed enabling um for threat F sensor suite for UAVs	1 2000	<u>. 1 2007</u>	1 2000	<u>1 1 2002</u>	
(U)	with severe size, weight, and power constraints, to enable single platform pers	intelligence experiment. bed enabling technologies sis for improved ground chniques. RF sensor suite for UAVs istent ISR capability					
	compatible with a system of systems architecture. Enhance the ground test be sensing modes, and provide input into the required design for an integrated EC including required data processing and exploitation. Continue sensor systems fostering the transition of developed enabling technologies and concepts to we assets. Continue experiments with the ground test bed providing input into a c multi-intelligence experiment. Continue radar system analysis for improved g detection using HRR advanced transmit waveform and mode techniques.	D/RF sensor suite, engineering support eapon systems and ISR lesign for an airborne					
	oject 665A	Page-6 of 22			Exhibit R-2a (		

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Sensors		UMBER AND TITLE anced Aerospace Sensors 39		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop weapons guidance quality track radar performance environments. Develop and demonstrate advanced radar signal processing tech and jamming interference, and improve detection and tracking of difficult target environments.	niques to mitigate clutter	0.499	0.771	1.266	0.980
(U)	In FY 2006: Demonstrated and evaluated adaptive processing techniques for m arrays and wideband and polarization adaptive processing techniques for multi- Implemented novel space-time adaptive processing techniques that are robust to Developed multi-sensor waveform transmission and signal processing technique computing architectures.	function radar. heterogeneous data.				
(U)	In FY 2007: Demonstrate and evaluate novel space-time adaptive processing te to heterogeneous data. Demonstrate and evaluate multi-sensor waveform transp processing techniques on selected advanced computing architectures.	-				
	In FY 2008: Demonstrate and evaluate multi-sensor waveform transmission an techniques on selected advanced computing architectures. Implement novel spa processing techniques that are robust to heterogeneous data. Implement tactical operations on the developed advanced computer architectures used for algorithm. In FY 2009: Demonstrate the surveillance performance of homogeneous sensor developed adaptive processing algorithms and waveforms in heterogeneous composition.	ce-time adaptive sensor network n/waveform analysis. r networks and newly				
	and jamming interference.					
(U) (U)	CONGRESSIONAL ADD: Tactical Air Communication Nodes (TACNODES		0.000	0.996	0.000	0.000
(U) (U)	In FY 2006: Not Applicable.	).	0.000	0.990	0.000	0.000
(U)	In FY 2007: Conduct Congressionally-directed effort for TACNODES.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Precision Image Tracking and Registration Program	n.	0.000	0.996	0.000	0.000
	In FY 2006: Not Applicable.					
(U)	In FY 2007: Conduct Congressionally-directed effort for the Precision Image a	nd Tracking Registration				
	Program.					
Dro		Line Item No. 21 Page-7 of 22			Exhibit R-2a (F	

	Exhibit	R-2a, RD	F&E Projec	t Justifica	tion				February	2007		
BUDGET ACTIVITY 03 Advanced Technology Develo	opment (ATD	)		0603	0603203F Advanced Aerospace 66				PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Fechnology			
(U) <u>B. Accomplishments/Planned</u>	Program (\$ in	Millions)				<u>FY 2</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) In FY 2008: Not Applicable.												
(U) In FY 2009: Not Applicable.						10		1 < 100	14000	10.000		
(U) Total Cost						12.3	573	16.428	14.800	13.020		
U) <u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u>	<u>(illions)</u>										
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	Total Cost		
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimat</u>	<u>e</u> <u>Estimate</u>	<u>Complete</u>	<u>Total Cost</u>		
(U) Related Activities:												
U) PE 0602204F, Aerospace												
Sensors.												
U) PE 0603205F, Flight Vehicle												
Technology.												
U) PE 0603707F, Weather												
Systems Advanced												
Development.												
U) PE 0603500F,												
Multi-Disciplinary Advanced												
Development Space Technology.												
U) PE 0602111N, Weapons												
Technology.												
U) PE 0602232N, Space and												
Electronic Warfare (SEW)												
Technology.												
U) PE 0604249F, LANTIRN												
Night Precision Attack.												
U) PE 0603270F, Electronic												
Combat Technology.												
U) A Memorandum of Agreement												
has been established between												
Air Force Research												
Laboratory and Defense												
Drainat 665 A			I	R-1 Line Item No					Evhibit D. 0c. /			
Project 665A				Page-8 of 22 386					Exhibit R-2a (F	r⊏ 0603203F		

Exhibit R-2a, RDT&E Project Justification DATE February 2007								
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors		T NUMBER AND TITLE					
<ul> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Advanced Research Projects Agency to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	R-1 Line Item No. 21							
Project 665A	Page-9 of 22 387		Exhibit R-2a (PE 0603203F)					

Exhibit R-2a, RDT&E Project Justification								DATE	DATE February 2007				
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)					06032	0603203F Advanced Aerospace 65				PROJECT NUMBER AND TITLE SPDF Target Attack and Recognition Fechnology			
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total		
69DF	Target Attack and Recognition Technology	25.898	29.659	28.435	29.462	29.002	28.546	29.110	30.187	Continuing	g TBD		
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0				
	and at maximum weapon launch rang advanced tracking for low radar cross techniques to support theater missile of warfighter exposure to hostile fire. T cueing, recognition, and identification apply these technologies to tactical ai high-threat, multiple target environme recognition. This project is maturing support theater missile defense efforts leverage efforts, providing for signifie	s section threats defense efforts his project also n of airborne an r-to-air and air ents. Model-ba these technolo s in surveillanc	s, and targeting in surveillance develops and ad ground-base -to-surface we ased vision alg gies in partner e and attack.	g using both of e and attack. demonstrates ed, high-value apon systems corithms and t rship with the Fire control at	on-board and o These fire cor s target identified time-critical so they are ab arget signature Defense Adva nd recognition	off-board sense introl technologication and rec targets at long ble to operate i e development anced Research technologies	or information gies will provi cognition tech ger ranges that in all weather t techniques an h Projects Age developed and	. This project de force multi nologies for p n are currently conditions, du re the key to ta ency, and eval d demonstrate	also evaluates plication and r ositive, high c possible. Th ring day or nig rget identification uating the tech d in this project	s targeting reduce onfidence e goal is to ght, and in ttion and hniques to ct are high			
(U) (U)	weapon systems. <b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop and test identifying moving and stationary gro	t an automatic ound targets fo	target recogni r use in strike	and reconnais	sance platform	-	<u>FY 20</u> 4.9		<u>7 2007</u> 5.025	<u>FY 2008</u> 5.666	<u>FY 2009</u> 0.267		
	In FY 2006: Developed radar-based reconnaissance platforms. Analyzed for algorithm transition to strike and	and identified	legacy system	-		es required							
(U)													
(U)	In FY 2008: Perform a real-time laboral algorithm for tactical and reconnaissa the warfighter as would be integrated	oratory demonstance platforms.	stration of a ra Assess perfo	dar based air- rmance again	to-ground mo st scenarios of	interest to							
Proje	Project 69DF R-1 Line Item No. 21 Project 69DF Page-10 of 22 388					1		Exhibit R-2a (PE 0603203F)					

	Exhibit R-2a, RDT&E Project	Justification		DATI	February	2007		
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Sensors	l Aerospace	69DF Targe	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology			
(U)	<b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b> the moving target algorithm technology to operational strike and reconnaissance	o platforms	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Continue providing support to the transition of the moving target operational strike and reconnaissance platforms.	-						
(U)								
(U)	MAJOR THRUST: Develop and assess multi-sensor ATR for Air Force intellir reconnaissance (ISR); strike; and weapon systems.	gence, surveillance, and	5.412	5.329	4.229	1.719		
(U)	In FY 2006: Assessed the performance of Air Force and Defense Advanced Re (DARPA) multi-sensor ATR fusion algorithms using the Air Force ATR evalual application to Air Force ISR, strike, and weapon systems. Characterized both a contributions from radar and EO, including hyperspectral imaging sensors with Completed the automation of data collection planning for transition of algorithm ATR research and development (R&D) computer and networking infrastructur and network integration enhancements. Completed the initial processing capable Department of Defense (DoD)-wide repository for R&D sensor data. Complete computational and collaborative environment to accelerate the transition of AT technologies. Developed synthetic data generation capability to augment and e and operational data sets. Assessed impact of automated multi-sensor automate fusion capability in terms of timeline reduction for time-critical targeting to im decision-makers in the experimental Air Operations Centers. Modeled platform simulated operational environments. Assessed moving target tracking and ide multiple sensor types. Evaluated automated exploitation and rapid response teat for post-conflict force protection, stability, and security operations. In FY 2007: Continue to assess the performance of Air Force and DARPA mutarget recognition fusion algorithms using the Air Force ATR evaluation test fa Air Force intelligence, surveillance, reconnaissance, strike, and weapon system characterizing both single and multiple sensor contributions from radar and EC imaging) sensors with automated exploitation. Collect, process, archive, and d for automated exploitation technology development and assessment with collaborative computing environ development of synthetic data generation capability to augment collected R&D sets. Augment the DoD-wide repository of R&D sensor data with multi-sensor	ation test facility for single and multiple sensor a automated exploitation. ms. Completed the initial e via software, hardware, oilities and the on-line ed the on-line integrated R and sensor fusion enhance existing R&D ic target recognition and age analysts and n and sensor systems in ntification approaches for chnology enhancements lti-sensor automatic cility for application to as. Continue (including hyperspectral istribute R&D sensor data automated exploitation ment. Complete and operational data r imagery and tracking						
	ject 69DF	Line Item No. 21				PE 0603203F)		

Exhibi	acced Technology Development (ATD)         D603203F Adv Sensors           ccomplishments/Planned Program (\$ in Millions)           collected at warfighter-sponsored exercises. Continue to show impact of automated multi-sensor and fusion capability in terms of timeline reduction for time-critical targeting to image analysts a ion-makers in the experimental Air Operations Centers. Initiate modeling of existing and emerge or systems for assessing automated exploitation technologies in simulated operational environmen the assessment of moving target tracking and ID approaches for multiple sensor types. Initiate ination of technology enhancements for post-conflict force protection, stability, and security ations.           Y 2008: Begin spiral development and assessment of multi-sensor ATR fusion algorithms. ssment of technology supporting Air Force intelligence, surveillance, reconnaissance, strike, and boon systems will occur in the Air Force ATR evaluation test facility. Continue spiral development validation of synthetic data generation capability critically needed to augment collected R&D and dependence of features to support development of an optimum data fusion exploitation capability. Ince ATR evaluation test facility and data sets as required to support enhanced ATR fusion bilities.           Y 2009: Continue spiral development and assessment of multi-sensor ATR fusion algorithms. inue assessment of technology supporting Air Force intelligence, surveillance, reconnaissance, e, and weapon systems using the Air Force ATR evaluation test facility. Continue spiral lopment and validation of synthetic data generation capability critically needed to augment cted R&D and operational data sets. Develop ATR fusion sensor data exploitation capability ing analysis and experimentation of data independence and interdependence of features to suppor lopment of an optimum data fusion exploi			DATE	DATE February 2007				
BUDGET ACTIVITY 03 Advanced Technology Development (ATD	)	PE NUMBER AND TITLE 0603203F Advanced Sensors	Aerospace		BER AND TITLE				
data collected at warfighter-sponsored exercise ATR and fusion capability in terms of timeline decision-makers in the experimental Air Opera sensor systems for assessing automated exploit Initiate assessment of moving target tracking an	s. Continue to show impact of au reduction for time-critical targeti- tions Centers. Initiate modeling of ation technologies in simulated of nd ID approaches for multiple ser	ng to image analysts and of existing and emergent perational environments. nsor types. Initiate	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U) In FY 2008: Begin spiral development and ass Assessment of technology supporting Air Force weapon systems will occur in the Air Force AT and validation of synthetic data generation capa operational data sets. Examine target, scene an interdependence of features to support development.	e intelligence, surveillance, recon 'R evaluation test facility. Continability critically needed to augme d scenario data to determine inde ment of an optimum data fusion e	naissance, strike, and nue spiral development nt collected R&D and pendence and exploitation capability.							
(U) In FY 2009: Continue spiral development and a Continue assessment of technology supporting strike, and weapon systems using the Air Force development and validation of synthetic data ge collected R&D and operational data sets. Deve utilizing analysis and experimentation of data in development of an optimum data fusion exploit and data sets as required to support enhanced A	Air Force intelligence, surveillan ATR evaluation test facility. Co eneration capability critically nee elop ATR fusion sensor data explo- ndependence and interdependence tation capability. Enhance ATR of TR fusion capabilities. Determin	tee, reconnaissance, ontinue spiral ded to augment oitation capability e of features to support evaluation test facility							
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop and demonstrate a capability for stationary and moving targets. N higher Air Force priorities.</li> <li>(U) In FY 2006: Developed high confidence comb</li> </ul>	a moderate confidence ATR and fote: Reduced emphasis on this e at identification capability to dete cessing techniques provide a high	ffort in FY 2008 due to ermine which confidence combat	3.389	9.267	7.816	10.620			
Project 69DF		Line Item No. 21 lage-12 of 22			Exhibit R-2a (P	PE 0603203E)			

Advanced Technology Development (ATD)       0603203F Advanced Aerospace Sensors         P B. Accomplishments/Planned Program (S in Millions)       FY 2006         experiments to refine high-level, near-term fusion processes. Conducted characterization studies of advanced stationary and mowing target radar data to determine utility for automatic target recognition and advanced cueing (ATR/C) and combat identification. Conducted technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Refined tool development to support sensor system, sensor management, and system performance analyses. Performed advanced multi-sensor, multi-platform fusion processing techniques.       No         10       In FY 2007: Further develop high confidence combat identification capability to determine which combination of sensors, modes, and fusion processing techniques provide a high confidence combat identification capability for stationary and moving ground targets. Further the technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Continue critical experiments of advanced multi-sensor technologies and fusion processing techniques for strike and ISR assets. Further characterize studies of advanced stationary and moving target multi-sensor data collections on stationary and moving targets.         11       FY 2008: Develop and evaluate an initial design of a 3D-LADAR ATR algorithm stat use change detection techniques to improve target detection and reduce false alarms for higher clutter areas. Develop and evaluate an initial design of a 3D-LADAR ATR algorithm designed to achieve high confidence identification against targets in various degrees of clutter. Develop and evaluate an initial design of a laser vibrometry sensors. Enhance ATR evalua	Exhibit R-2a, RDT&E Projec	ct Justification	DATI	February	2007	
<ul> <li>experiments to refine high-level, near-term fusion processes. Conducted characterization studies of advanced stationary and moving target radar data to determine utility for automatic target recognition and advanced cueing (ATR/C) and combat identification. Conducted technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Refined tool development to support sensor system, sensor management, and system performance analyses. Performed advanced multi-sensor data collections on stationary and moying targets.</li> <li>In FY 2007: Further develop high confidence combat identification capability to determine which combination of sensors, modes, and fusion processing techniques provide a high confidence combat identification capability for stationary and moving ground targets. Further the technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Continue critical experiments of advanced multi-sensor, multi-platform technologies and fusion processing techniques for strike and ISR assets. Further characterize studies of advanced stationary and moving targets.</li> <li>In FY 2008: Develop and evaluate an initial design of multi-sensor fusion algorithms that use change detection techniques to improve target detection and reduce false alarms for higher clutter areas. Develop and evaluate an initial design of allowing targets.</li> <li>In FY 2008: Develop and evaluate an initial design of caploithm designed to achieve high confidence identification against targets in various degrees of clutter. Develop and evaluate an initial design of a 3D-LADAR ATR algorithm design of a sensor management suite that provides target rouged of a sensor management suite that provides target cue prioritizations and look geometry optimized for use with 3D-LADAR sensors. Develop and evaluate an initial design of the valuation tof sensor management suite that provides target in various degrees of clutter. Develop and evalu</li></ul>	BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	0603203F Advanced Aerospace		UMBER AND TITLE In Attack and Recognition BY		
<ul> <li>advanced stationary and moving target radar data to determine utility for automatic target recognition and advanced cueing (ATR/C) and combat identification. Conducted technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Analyzed characterization studies for advanced, multi-sensor, multi-platform fusion processing techniques.</li> <li>Refined tool development to support sensor system, sensor management, and system performance analyses. Performed advanced multi-sensor data collections on stationary and moving targets.</li> <li>In FY 2007: Further develop high confidence combat identification capability to determine which combination of sensors, modes, and fusion processing techniques provide a high confidence combat identification capability for stationary and moving ground targets. Further the technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Continue critical experiments of advanced multi-sensor, multi-platform technologies and fusion processing techniques for strike and ISR assets. Further characterize studies of advanced stationary and moving target multi-sensor data collections on stationary and moving target multi-sensor data to determine utility for ATR/C and combat identification. Further refine tool development to support sensor system, sensor management, and system performance analyses. Continue advanced multi-sensor data collections on stationary and moving targets.</li> <li>In FY 2008: Develop and evaluate an initial design of multi-sensor fusion algorithms that use change detection techniques to improve target detection and reduce false alarms for higher clutter areas. Develop and evaluate an initial design of a 3D-LADAR ATR algorithm designed to achieve high confidence identification capability. Develop and evaluate an initial design of a sensor management suite that provides the ability. Develop and evaluate an initial design of a sensor management suite that pr</li></ul>	(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>confidence identification against targets in various degrees of clutter. Develop and evaluate an initial design of a laser vibrometry algorithm that provides the ability to determine target state (engine on/off) and provides counter denial and deception capability. Develop and evaluate an initial design of a sensor management suite that provides target cue prioritizations and look geometry optimization for 3D-LADAR sensors. Develop and evaluate an initial set of exploitation tools that are optimized for use with 3D-LADAR and laser vibrometry sensors. Enhance ATR evaluation test facility and data sets as necessary to support program requirements.</li> <li>in FY 2009: Incorporate improvements in the initial design of the multi-sensor fusion algorithms for improved detection that were previously evaluated. Incorporate improvements in the initial design of the 3D-LADAR ATR algorithms that were previously evaluated. Incorporate improvements in the</li> </ul>	<ul> <li>experiments to refine high-level, near-term fusion processes. Conducted cha advanced stationary and moving target radar data to determine utility for aut and advanced cueing (ATR/C) and combat identification. Conducted technol of promising near-term, multi-sensor technologies and fusion processing technacterization studies for advanced, multi-sensor, multi-platform fusion processing techniques. Performed advanced multi-sensor data collections on stationary at analyses. Performed advanced multi-sensor data collections on stationary at identification capability for stationary and moving ground targets. Further the effort of promising near-term, multi-sensor technologies and fusion processis critical experiments of advanced multi-sensor technologies and fusion processis critical experiments of advanced multi-sensor technologies and fusion processis critical experiments of advanced multi-sensor, multi-platform technologies at techniques for strike and ISR assets. Further characterize studies of advanced target multi-sensor data collections on stationary and moving targets.</li> <li>(U) In FY 2008: Develop and evaluate an initial design of multi-sensor fusion a detection techniques to improve target detection and reduce false alarms for</li> </ul>	aracterization studies of comatic target recognition ology demonstration effort hniques. Analyzed rocessing techniques. d system performance and moving targets. ity to determine which high confidence combat he technology demonstration ing techniques. Continue and fusion processing ed stationary and moving ation. Further refine tool formance analyses. Continue	<u>11200/</u>	<u>r 1 2009</u>	<u>F1 2007</u>	
improvements in the initial design of the sensor management suite that were previously evaluated. R-1 Line Item No. 21	<ul> <li>confidence identification against targets in various degrees of clutter. Devel design of a laser vibrometry algorithm that provides the ability to determine and provides counter denial and deception capability. Develop and evaluate management suite that provides target cue prioritizations and look geometry 3D-LADAR sensors. Develop and evaluate an initial set of exploitation too with 3D-LADAR and laser vibrometry sensors. Enhance ATR evaluation tenecessary to support program requirements.</li> <li>(U) In FY 2009: Incorporate improvements in the initial design of the multi-sen improved detection that were previously evaluated. Incorporate improvements the 3D-LADAR ATR algorithms that were previously evaluated. Incorporationation initial design of the laser vibrometry algorithms that were previously evaluated improvements in the initial design of the laser vibrometry algorithms that were previously evaluated. Incorporationation initial design of the laser vibrometry algorithms that were previously evaluated. Incorporate improvements in the initial design of the laser vibrometry algorithms that were previously evaluated. Incorporate improvements in the initial design of the laser vibrometry algorithms that were previously evaluated.</li> </ul>	lop and evaluate an initial target state (engine on/off) e an initial design of a sensor optimization for ls that are optimized for use est facility and data sets as soor fusion algorithms for nts in the initial design of te improvements in the ted. Incorporate previously evaluated. R-1 Line Item No. 21		Exhibit R-2a (	PE 0603203F)	

	Exhibit R-2a, RDT&E Project	DATE February 2007				
	T ACTIVITY vanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advance Sensors			/BER AND TITLE t Attack and F /	Recognition
In	<b>3. Accomplishments/Planned Program (\$ in Millions)</b> ncorporate improvements in the initial set of laser sensor exploitation tools the valuated. Enhance ATR evaluation test facility and data sets to support program.	· ·	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	valuated. Emilance refer evaluation test facility and data sets to support prog	sium requirements.				
ge (U) In te	AAJOR THRUST: Develop and demonstrate an ATR capability integrated v georegistration techniques and innovative change detection algorithms. In FY 2006: Completed integration and field test of ATR/C, georegistration, echniques. Utilized the advanced recognition capability test bed to integrate argeting (TCT) capability and support transition to the warfighter. Complete	and change detection and upgrade time-critical	5.291	5.853	2.846	1.112
te st m in ta	esting of a capability that continuously tracks TCTs and reduces the kill chai trike platforms target acquisition time. Designed and developed an autonom nanagement and data exploitation system supporting an all-weather mission f ncluding unmanned aerial vehicles (UAVs). Conducted critical experiments arget identification (ID) phenomenology. Conducted data collection, modeli ensors, platforms, and concept of operations.	n through a reduction in ous multi-sensor for tactical platforms, to investigate concealed				
Te ta m pl de ar of	In FY 2007: Continue to utilize the advanced recognition capability test bed CCT capability to support the transition to the warfighter of technology produ- argets and improve ability to dynamically track TCTs. Continue developmen- nulti-sensor management and data exploitation system supporting an all-wea- datforms, including unmanned aerial vehicles (UAV). Initiate design and co- lemonstration of a concealed target ID sensor and exploitation capability. In n advanced tracking capability that utilizes advanced radar features to finger observations and integrates multiple radar sensors to maintain continuous trac- nd in dense traffic.	acts that detect concealed nt of an autonomous ther mission for tactical nduct concept itiate the development of print and associate vehicle				
de A ge in Pe te	n FY 2008: Continue spiral assessment and development of ATR/C, geo-reg detection technology. Assessment of technology supporting Air Force TCT s Air Force ATR evaluation test facility. Continue spiral development and vali- generation capability critically needed to augment collected R&D and operati- interim demonstration and evaluation of concealed target ID sensing and expl Perform interim demonstration and evaluation of advanced tracking and mult echnology in a militarily significant scenario. Enhance ATR evaluation test upport TCT capabilities.	systems will occur in the dation of synthetic data ional data sets. Perform loitation technologies. i-sensor track maintenance				
	xt 69DF	-1 Line Item No. 21				

	Exhibit R-2a, RDT&E Pro	ject Justification		DATE	February	2007	
BUDGET ACTIVITY 03 Advanced To	echnology Development (ATD)	PE NUMBER AND TITLE 0603203F Advance Sensors				TLE Ind Recognition	
(U) In FY 2009: and change of occurring in synthetic data sets. Demon Enhance AT Determine to to overcome	<b>ishments/Planned Program (\$ in Millions)</b> Determine need to continue spiral assessment and developer detection technology. Continue assessment of technology su the Air Force ATR evaluation test facility. Continue spiral ta generation capability critically needed to augment collected astrate TCT, advanced target tracking, and multi-sensor track R evaluation test facility and data sets as required to support echnology shortfalls and develop emerging TCT and advance these shortfalls.	apporting Air Force TCT development and validation of ed R&D and operational data c maintenance capabilities. t enhanced TCT capabilities.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	RUST: Develop Identify Friend, Foe, or Neutral (IFFN) air- and non-cooperative identification techniques. Note: This w		1.889	2.890	2.878	2.026	
<ul> <li>(U) In FY 2006: combat ID s moving grou for non-coop make ground operation us to closely co cooperative to define a s exploitation.</li> <li>(U) In FY 2007:</li> </ul>	Conducted design studies to develop technologies to impro ystems used to sort friend/foe/neutral entities during air-to-g and vehicles. Studies included ground target database enhan- perative ID of moving targets, and RF tags for cooperative ta d target databases more robust and affordable for application ing real or synthetic data, and for modeling denied targets. I puple tracking with ID functions, exploit unique RF phenome and non-cooperative ID methods. Assessed RF tag systems ystem architecture, defined techniques to assure secure data and defined interfaces for cross-service or coalition interoper Finalize design studies and initiate critical experiments to ver-	round attack of stationary and cements, advanced algorithms rget ID. Defined techniques to using multiple sensors, for Developed advanced algorithms enology, and integrate versus warfighter requirements exchange without threat of erability. erify improved ground target ID					
advanced RI measure imp testing to co and perform screening lat against diffi	resulting from ground target database enhancements, ID algo F tags. Refine advanced ID algorithms and laboratory test w proved confidence/reliability of target ID. Finalize RF tag d nfirm improved pilot/system operator situation awareness, ve initial interoperability assessments. Improve exploitation to rge volumes of ISR imagery. Develop technology for wide a cult, asymmetric targets at long range. Develop and integrate I UAVs with EO/IR sensors to provide persistent ISR.	ith operational sensor data to esign and conduct simulation erify friendly ID confirmations, pols to allow automatic area detection, tracking, and ID					
Project 69DF		R-1 Line Item No. 21 Page-15 of 22			Exhibit R-2a (	PE 0603203E)	

	Exhibit R-2a, RDT&E Project Ju	stification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Sensors	d Aerospace		IBER AND TITLE t Attack and F	
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	In FY 2008: Integrate and demonstrate improved ground target ID capabilities the databases, ID algorithm advancements, and RF tags in a laboratory environment. technology via a combination of exercises and scientific analysis by the Air Force facility. Initiate spiral assessment and development of IFFN air-to-ground capabilitation facilities and target databases as necessary. Plan operational exercise support.	Assess maturity of ATR evaluation test lity enhancing test				
(U)	In FY 2009: Continue to integrate and demonstrate improved ground target ID ca enhanced target databases, ID algorithm advancements, and RF tags in an operation Assess performance of technology to support warfighter integration with operation refinement of ID algorithms and target databases as necessary to support transition	onal environment. nal systems. Continue				
(U)						
	MAJOR THRUST: Develop wide angle, continuous staring, multi-sensor/multi-v and automated exploitation technology that provides detection, tracking and ident objects of possible military significance over very large ground areas at sensor day This work is an outgrowth of other work within this project. In FY 2006: Not Applicable.	ification of numerous	0.000	0.000	5.000	5.000
	In FY 2007: Not Applicable.					
	In FY 2008: Design and breadboard the individual waveband sensors required to staring and automated exploitation capability. Collect data required to support the and validation of the automated exploitation of the wide angle, continuous staring maturity of the technology through scientific analyses conducted in the Air Force evaluation test facility.	e development, testing capability. Assess the				
(U) (U)	In FY 2009: Design and develop engineering model of the multi-sensor/multi-wa continuous staring capability building upon the technologies developed during the stage. Integrate and demonstrate wide angle, continuous staring component techn maturity of the technology via a combination of exercises and scientific analyses l evaluation test facility. Initiate spiral development of wide angle, continuous star algorithms; phenomenological modeling; and target and scenario databases necess transition to the warfighter.	e individual component ologies. Assess the by the Air Force ATR ing exploitation				
	MAJOR THRUST: Develop an advanced suite of sensors with ATR, fusion, and working in concert to provide a high confidence identification capability. Note: T	•	0.000	0.000	0.000	8.718
Bro		ne Item No. 21			Exhibit R-2a (	
P10		ge-16 of 22 <b>394</b>			Exhibit K-2a (	FE 0003203F)

		Exhibit	t R-2a, RD1	&E Projec	t Justifica	tion			DATE	February	2007
	GET ACTIVITY Advanced Technology Develo	opment (ATD	)		0603	UMBER AND TIT 3203F Advan sors	⊡E ced Aerospa	ce 6	ROJECT NUMB 9DF Target A echnology	ER AND TITLE	
(U)	<b>B.</b> Accomplishments/Planned	Program (\$ in	<u>Millions)</u>				<u>FY 20</u>	<u>)06 I</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	outgrowth of other work within	this project.									
	In FY 2006: Not Applicable.										
(U)	In FY 2007: Not Applicable.										
	In FY 2008: Not Applicable.	advanced aimm	aint trading a	anahility Day	alon and toot A	TD					
(U)	In FY 2009: Design and test an capability using EO sensor data.	-	-		-						
	develop a high confidence explo			-							
	information and exploitation res		-		•						
	development of algorithm pheno										
	support technology developmen										
	Force ATR test facility and sens										
(U)											
(U)	CONGRESSIONAL ADD: Nat	-	nal Signature P	roduction and	Research Capa	bility	5.0	)11	1.295	0.000	0.000
	(Combat Identification Signature										
(U)	In FY 2006: Conducted Congre	•		-	ional Signature	Production					
(II)	and Research Capability (Comb		-		al Cianatana D						
(0)	In FY 2007: Conduct Congress and Research Capability (Comb	•		-	hal Signature P	roduction					
an	In FY 2008: Not Applicable.			1101).							
	In FY 2009: Not Applicable.										
	Total Cost						25.8	398	29.659	28.435	29.462
(U)	C. Other Program Funding Su	mmary (\$ in N	(fillions)								
(0)	<u>C. Other Program Funding Su</u>	<u>FY 2006</u>	<u>FY 2007</u>	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	
		<u>Actual</u>	Estimate	Estimate	<u>Estimate</u>	Estimate	<u>Estimate</u>	Estimate	<u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	I OTAL COST
Л	Related Activities:	<u>netuar</u>	Lstinate	Listinate	Listimate	LStillate	Lstinate	Listimate	Littinate	<u>complet</u>	¥
• •	PE 0602204F, Aerospace										
	Sensors.										
(U)	PE 0603253F, Advanced										
	Sensor Integration.										
` '	PE 0603500F,										
	Multi-Disciplinary Advanced										
Proi	ect 69DF			F	R-1 Line Item No Page-17 of 22					Exhibit R-2a (	DE 0603203E1
F10					395						FE 0003203F)

Exhibit R-2a, RDT&E Pr	oject Justification	DATE	February 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors		BER AND TITLE Attack and Recognition
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>			
<ul> <li>Space Technology.</li> <li>(U) PE 0603762E, Sensor and Guidance Technology.</li> <li>(U) PE 0603270F, Electronic Combat Technology.</li> <li>(U) Theater Missile Defense System Program Office.</li> <li>(U) Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System Program Office.</li> </ul>			
<ul> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>			
(U) <b>D. Acquisition Strategy</b> Not Applicable.			
Project 69DF	R-1 Line Item No. 21 Page-18 of 22 <b>396</b>		Exhibit R-2a (PE 0603203F)

		Exhibit R-	2a, RDT&E	E Project	Justificatio	on			Ľ	DATE	February	2007
	ET ACTIVITY dvanced Technology Developme	ent (ATD)				IBER AND TITL 03F Advanc ors		ce			R AND TITLE d Space Se	nsors
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	2 FY 2	2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate		mate	Complete	
88SP		0.000	12.141	12.314	10.358	8.065	8.188	8.3	55	8.537	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0	0		
	In FY 2007, efforts transferred from er to more effectively manage and pro		-		d Developmer	nt Space Tech	nology, Projec	et 5034, Ac	lvanced Sj	pace Se	nsors, to this	project
(	A. Mission Description and Budget This project develops and demonstrate electro-optical sensors; laser warning developing multi-function radar, laser precisely detect, track, and target air-	es space senso sensors; target , electronic co	r technologies, ing and attack mbat, and ECC	radar sensors CM technolog	; and electroni gies for space a	ic counter-cou opplications, th	ntermeasures is project pro	(ECCM) a vides spac	nd commu e platform	unicatio s with t	ns. By	
(U)	<b>B. Accomplishments/Planned Progr</b>	<u>am (\$ in Mill</u>	<u>ions)</u>				<u>FY 20</u>	<u>06</u>	<u>FY 2007</u>		<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Reduce technolog		ce sensor platf	form payload	components an	nd	0.0	00	0.741		0.554	0.603
	exploitation of infrastructure integrati	on.										
	In FY 2006: Not Applicable.											
	In FY 2007: Integrate space-sensor te	-	-		simulation tes	st bed with						
	selected hardware in the loop and den											
	In FY 2008: Develop approach to des hardware implementation feasibility. standards.			-		-						
(U) (U)	In FY 2009: Develop "plug-n-play" s	atellite critica	l experiment, t	o include full	simulation.							
	MAJOR THRUST: Develop and den (GPS) jam resistance, positional accur offensive and defensive combat capab In FY 2006: Not Applicable.	racy, timing a	-		-	•	0.0	00	1.145		1.859	1.871
· · ·	11	tributed model	on moviention	and timina	(DNT) to she al	action to						
	In FY 2007: Develop space-based dis detect, identify, and locate GPS threat assess networked clusters of unmanne	ts. Develop m	ulti-ship virtua	al flight test si	imulation tech	nology to						
(U)	platforms. In FY 2008: Demonstrate space-base threats. Demonstrate multi-ship virtu		-		•							
Proje	ect 88SP				Line Item No. 2 <sup>-</sup> Page-19 of 22	1					Exhibit R-2a (P	'E 0603203F)
					397							

	Exhibit R-2a, RDT&E Project J	ustification		DATE February 2007				
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advance Sensors		PROJECT NUMBER AND TITLE 88SP Advanced Space Sensors				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	UAVs, ISR platforms, and space-based platforms. In FY 2009: Design space-based distributed position, navigation, and timing tech optimal sensor fusion for a Common Operational Picture (COP). Design multi-si simulation technology to assess world-wide distributed PNT architectures for dist the COP.	nip virtual flight test						
(U)								
	MAJOR THRUST: Develop electro-optical (EO) sensor component technology space mission areas. Develop new sensor components, topologies, and architectu	-	0.000	1.675	1.683	1.229		
(U)	In FY 2006: Not Applicable.							
(U)	In FY 2007: Fabricate advanced space environment phenomonology sensor com	-						
(U)	In FY 2008: Conduct experimental space flight of sensor components to test in s Initiate data collection, testing and system evaluation with relevant space enviror	-						
(U)	In FY 2009: Complete experimental space flight of sensor components to test in Complete data collection, testing and system evaluation. Initiate lab-based integreembedded satellite components.	±						
(U)								
(U)	MAJOR THRUST: Develop advanced laser communication component and sub support a network-level topology for Airborne ISR.	-system technology to	0.000	5.000	6.349	5.000		
(U)	In FY 2006: Not Applicable.							
(U)	In FY 2007: Begin development of an integrated wideband radio frequency (RF) terminal and shared aperture antenna for evaluation and testing in an air network development of technologies for shared RF/EO apertures to service high bandwide needs. Continue testing applicability of shared apertures to maintaining air network under in weather conditions. Expand flight demonstrations of air network layer to optical, and combined RF/optical communication terminals.	layer. Continue Ith communication ork link connectivity echnologies for RF,						
(U)	In FY 2008: Continue development of an integrated wideband RF/EO communic shared aperture antenna. Begin evaluation and testing of the integrated terminal network layer. Begin maturation of technologies for integration into communicat Continue flight demonstrations of air network layer technologies for RF, optical, RF/optical communication terminals.	and antenna in an air ion architecture.						
(U)	In FY 2009: Continue maturation of technologies for integration into communic	ation architecture.						
		ine Item No. 21						
	ject 88SP Pa	ige-20 of 22			Exhibit R-2a (			

		Exhibit	: R-2a, RD	Г&E Projec	t Justifica	tion			DATE	February	2007	
	GET ACTIVITY Advanced Technology Devel	Accomplishments/Planned Program (\$ in Millions) Accomplishments/Planned Program (\$ in Millions) thinue multi-configuration flight demonstrations of air network la combined RF/optical communication terminals. JOR THRUST: Develop and demonstrate geodesic phased array anced satellite operations over current reflector antennas. Improv ciency to support satellite control network. Note: Increased emprer to accelerate program to meet the end user's timeline. <sup>3</sup> Y 2006: Not Applicable. <sup>3</sup> Y 2007: Analyze system requirements and complete the design enna. Finalize RF and mechanical designs of the geodesic dome formance characteristics. Complete evaluation of the transmit/rec nent, beamformer array panels, and the antenna resource manage <sup>3</sup> Y 2008: Fabricate transmit/receive modules, radiating elements. PAA dome sub-sector to be used in the advanced technology dem <sup>3</sup> Y 2009: Fully characterize the ATD sub-sector and demonstrate al Cost Deter Program Funding Summary (\$ in Millions) <u>FY 2006</u> <u>FY 2007</u> <u>FY</u> <u>Actual</u> <u>Estimate</u> <u>Esti-</u> neted Activities: 0602204F, Aerospace sors. 0602500F, ti-Disciplinary Space hnology.				UMBER AND TI <b>3203F Advan</b> sors	TLE I <b>ced Aerosp</b> a			BER AND TITLE	d title Dace Sensors	
(U)	Continue multi-configuration fl	ight demonstrat	ions of air netw	vork layer tech	nologies for Rl	F, optical,	<u>FY 2</u>	006	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Develop ar enhanced satellite operations ov efficiency to support satellite co	nd demonstrate g ver current reflect ontrol network.	geodesic phase ctor antennas. Note: Increase	Improve opera	tional capacity	and	0.0	000	3.580	1.869	1.655	
(U) (U)	In FY 2006: Not Applicable. In FY 2007: Analyze system re antenna. Finalize RF and mech performance characteristics. Co	equirements and anical designs o omplete evaluation	complete the of the geodesic on of the trans	dome panels to mit/receive mo	o demonstrate o odules, the radi	critical						
(U) (U)	GDPAA dome sub-sector to be	used in the adva	anced technolo	gy demonstrati	ion (ATD).							
(U)	Total Cost						0.0	000	12.141	12.314	10.358	
(U)	C. Other Program Funding Su	<u>ımmary (\$ in N</u>	<u>fillions)</u>									
				<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	FY 2011 Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>		
` ´	Related Activities: PE 0602204F, Aerospace Sensors.											
(U)	PE 0602500F, Multi-Disciplinary Space											
(U)	PE 0603500F, Multi-Disciplinary Advanced Development Space											
(U)	Technology. PE 0603270F, Electronic Combat Technology.				R-1 Line Item No							

Exhibit R-2a, RDT&E P	Project Justification	DATE February 200	7
UDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 88SP Advanced Space Sensor	
<ul> <li><b>C. Other Program Funding Summary (\$ in Millions)</b></li> <li>This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> <li><b>D. Acquisition Strategy</b></li> </ul>			
Not Applicable.			
Project 88SP	R-1 Line Item No. 21 Page-22 of 22	Exhibit R-2a (PE 060	<u>0320</u> 31

#### PE NUMBER: 0603211F PE TITLE: Aerospace Technology Dev/Demo

	Exhibit R-2, RDT&E Budget Item Justification										E February 2007	
	BUDGET ACTIVITY     PE NUMBER AND TITLE       D3 Advanced Technology Development (ATD)     0603211F Aerospace Technology Dev/Demo											
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
	Total Program Element (PE) Cost	38.753	36.286	64.922	56.345	111.088	94.320	95.946	114.256	Continuing	TBD	
486U	Advanced Aerospace Structures	9.226	7.372	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD	
4920	Flight Vehicle Tech Integration	29.527	26.125	64.922	56.345	111.088	94.320	95.946	114.256	Continuing	TBD	
99SP	Advanced Structures Space Vehicles	0.000	2.789	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD	

Note: In FY 2006, efforts from Project 486U transfered into Project 4920 within this PE. Funds for the FY 2006 Congressionally-directed Design Manual for Titanium Honeycomb Sandwich Composite in the amount of \$3.253 million were moved to PE 0603211F, Aerospace Technology Dev/Demo from PE 0603112F, Advanced Materials for Weapon Systems, for execution. In FY 2007, Project 6399SP, Advanced Structures for Space Vehicles, efforts were transferred from PE 0603500F, Multidisciplinary Advanced Space Technology, Project 635062, Advanced Structures for Space Vehicles, order to effectively manage and provide oversight of the efforts. Funds for the FY 2007 Congressionally-directed Short Take Off and Landing Herk 1 Continuation in the amount of \$1.594 were moved into PE 0603211F, Aerospace Technology Dev/Demo, from PE 0401115F, C-130 Airlift Squadron, for execution.

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

This program demonstrates advanced aerospace vehicle technologies. Advanced aerospace structures are demonstrated to sustain and enhance the capability of current and future aerospace vehicles, such as a next generation bomber. Flight vehicle technology integration is accomplished through integration of various technologies to include avionics, advanced propulsion, and weapon systems for demonstration in near-realistic operational environments. Note: In FY 2007, Congress added \$1.0 million for 3-D Woven/Braided Composites, \$1.0 million for the Advanced Aerospace Titanium Structures (AATS) Initiative, \$1.0 million for the Advanced Aluminum Aerostructures Initiative (A3I), \$1.3 million for Large Composite Affordable Composite Structures, \$1.7 million for the National Capabilities Analysis Collaborative, Phase 3, \$1.1 million for Titanium Honeycomb Sandwich and Composite Structures, and \$1.6 million for Short Take Off and Landing (STOL) Herk 1 Continuation. This program is in the Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing aerospace vehicle system upgrades and/or new system developments that have military utility and address warfighter needs.

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Exhibit R-2, RDT&E Bu	DATE Februai	DATE February 2007		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Tech	nology Dev/Demo	)	
(U) <u>B. Program Change Summary (\$ in Millions)</u>				
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	53.657	27.424	57.925	114.655
(U) Current PBR/President's Budget	38.753	36.286	64.922	56.345
(U) Total Adjustments	-14.904			
(U) Congressional Program Reductions				
Congressional Rescissions	0.280	-0.138		
Congressional Increases		31.100		
Reprogrammings	-14.327	-22.100		
SBIR/STTR Transfer	-0.857			

#### (U) Significant Program Changes:

FY 2006 changes are the result of moving Congressionally-directed efforts from this PE to the proper PEs for execution and increased emphasis being placed on improving lift and performance capability of manned and unmanned platforms in Project 4920 within this PE.

FY 2007 changes are the result of moving Congressionally-directed efforts from this PE to the proper PEs for execution.

(U) C. Performance Metrics

Under Development

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	Exhibit R-2a, RDT&E Project Justification										DATE February 2007		
	ACTIVITY anced Technology Developme	ent (ATD)				IBER AND TITL 11F Aerospa emo		PROJECT NUMBER AND TITLE <b>486U Advanced Aerospace</b> <b>Structures</b>					
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total		
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete			
486U	Advanced Aerospace Structures	9.226	7.372	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD		
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0				
<ul> <li>Note: In FY 2006, efforts from Project 486U transfer into Project 4920 within this PE.</li> <li>(U) <u>A. Mission Description and Budget Item Justification</u> This project develops and demonstrates affordable aerospace vehicle technologies to sustain the existing fleet, reduce the cost of aircraft ownership, and capability of current and future aerospace vehicles. Sustainment of the existing fleet through extended operational service life with innovative technologies will lead to reduced operations and support costs, and increased operational readiness. Analytical certification will reduce the cost associated with comparely replacement by allowing and certifying new designs under reduced test requirements. Development of capability enhancing technologies will expand the envelope and increase survivability in high threat environments. Demonstration of these technologies will restore structural integrity, extend structural I the capability, and reduce the life cycle costs of fielded aircraft.</li> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) CONGRESSIONAL ADD: Design Manual for Titanium Honeycomb Sandwich Composite Structure.</li> <li>(U) In FY 2006: Initiated Congressionally-directed effort for design manual for titanium honeycomb sandwich composite structure.</li> </ul>								blogy applicat component d the operation	ion nal				
sar           (U)         In           (U)         In           (U)         CC           (U)         In	FY 2007: Continued Congressionandwich composite structure. FY 2008: Not Applicable. FY 2009: Not Applicable. ONGRESSIONAL ADD: Fly-By-La FY 2006: Continued Congressionan FY 2007: Not Applicable. FY 2008: Not Applicable. FY 2009: Not Applicable.	ight. Illy-directed ef Brothers Institu	fort for fly-by te - Capabiliti	r-light. es Analysis P	hase 2.	comb	2.0 4.0		0.000 1.694	0.000	0.000		
(U) In (U) In	FY 2006: Continued Congressiona FY 2007: Continued Congressiona FY 2008: Not Applicable. FY 2009: Not Applicable. 486U	•	-	ilities plannin R-1	• • • •	2				Exhibit R-2a (F	2E 0603211F)		

Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TIT 0603211F Aerosp Dev/Demo		PROJECT NUMBE	JECT NUMBER AND TITLE U Advanced Aerospace Inctures		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: 3-D Woven/Braided Composites</li> <li>(U) In FY 2006: Not Applicable</li> </ul>		0.000	0.996	0.000	0.000	
<ul> <li>(U) In FY 2007: Initiated Congressionally-directed effort for 3-D woven/braided compt</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>						
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Advanced Aerospace Titanium Structures (AATS) Init</li> <li>(U) In FY 2006: Not Applicable</li> </ul>	0.000	0.996	0.000	0.000		
<ul> <li>(U) In FY 2007: Initiated Congressionally-directed AATS effort.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>						
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Advanced Aluminum Aerostructures (A3I) Initiative.</li> <li>(U) In FY 2006: Not Applicable</li> </ul>	0.000	1.295	0.000	0.000		
<ul> <li>(U) In FY 2007: Continued Congressionally-directed A3I effort, last funded by Congre</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	ss in FY 2005.					
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Large Scale Affordable Composite Structures</li> <li>(U) In FY 2006: Not Applicable</li> </ul>		0.000	1.295	0.000	0.000	
<ul> <li>(U) In FY 2007: Initiated Congressionally-directed effort for large-scale affordable con</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	nposite structures.					
(U) (U) Total Cost		9.226	7.372	0.000	0.000	
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>						
	2009FY 2010imateEstimate	FY 2011FY 20EstimateEstim		<u>Cost to</u> <u>Complete</u>	Total Cost	
<ul><li>(U) Related Activities:</li><li>(U) PE 0602201F, Aerospace</li></ul>						
Project 486U Page	Item No. 22 e-4 of 12			Exhibit R-2a (	PE 0603211F)	
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Exhibit R-2a, RDT&E Pr	DATE February 200	DATE February 2007		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER AND TITLE 486U Advanced Aerospace Structures		
<ul> <li>(U) C. Other Program Funding Summary (\$ in Millions) Vehicle Technologies.</li> <li>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>				
Project 486U	R-1 Line Item No. 22 Page-5 of 12 405	Exhibit R-2a (PE 060	<u>)3211F</u>	

	Exhibit R-2a, RDT&E Project Justification									February 2	2007
	ET ACTIVITY Ivanced Technology Developme	ent (ATD)					E ace Technol		OJECT NUMBE	R AND TITLE hicle Tech Ir	ntegration
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
4020		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	TDD
4920	Flight Vehicle Tech Integration	29.527	26.125	64.922	56.345	111.088	94.320	95.946		Continuing	TBD
Note	Quantity of RDT&E Articles In FY 2006, efforts from Project 486	0 U transforrad	0 Into Project 40	0 20 within this	0	0	0	0	0		
	A. Mission Description and Budget This project integrates and demonstrat inmanned aerospace vehicles. System lemonstration in a near-realistic opera operational aircraft. This program pro iffordability. B. Accomplishments/Planned Progr	es advanced fin 1 level integrational environion 1 wides proven a	ight vehicle te ion brings tog ment. Integra ærospace vehi	ether the aero tion and techr	space vehicle ology demons	technologies a strations reduc	along with avi e the risk and	onics, propuls time required with improved	sion, and weap l to transition t	on systems for echnologies ir	r
(U)	MAJOR THRUST: Develop autonon between manned and unmanned air pl demonstration efforts related to autom	nous flight cor atforms. Note nated situation	trols for safe f The FY 200 al awareness f	9 increase in for unmanned	funding is due air systems.	to the	7.6		5.239	6.379	14.411
	In FY 2006: Completed hardware-in- colerant, autonomous control system s effectiveness for unmanned vehicle sy and control elements for flight critical flight-testing. Flight demonstrated au	uite to verify systems. Comp control. Prep tomated see an	significantly ir leted environn ared key photo nd avoid capab	acreased reliant mental testing ponic sensing a pility for unma	bility and miss of key photon and control eles anned air vehic	ion ic sensing ments for cles.					
	In FY 2007: Complete ground simula systems for adaptive, fault tolerant, au development of situational awareness for unmanned air vehicles.	itonomous unr	nanned air vel	nicle airborne	control. Initia	te					
	In FY 2008: Further develop situation ground operations for unmanned air v systems technologies for air base grou	ehicles. Incor	porate electroi	nagnetic threa							
(U)	In FY 2009: Conduct ground demons automated air base ground operations reaming of small unmanned air vehicl validation and verification tools and p vehicle flight control software. Refine	trations of situ for unmanned es in complex rocess for affo	ational aware air vehicles. low altitude e ordable certific	ness and contr Develop and c environments. eation of autor	demonstrate co Conduct eval nomous unmar	ooperative luation of med air					
Proje	ct 4920				Line Item No. 22 Page-6 of 12 406	2				Exhibit R-2a (PI	E 0603211F)

	Exhibit R-2a, RDT&E Project Justification DATE February 2007							
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospac Dev/Demo			JECT NUMBER AND TITLE 0 Flight Vehicle Tech Integration			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> systems technologies for air base ground operations for unmanned air vehicles.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop, simulate, and demonstratechnologies to improve the performance of manned and unmanned platforms. Not decrease is due to completion of a majority of the thrust objectives in FY 2006. In emphasis being placed on demonstration efforts related to the composite affordability of the thrust objective in formation of the thrust objective in forma	te: The FY 2007, FY 2008, increased	10.388	3.037	41.349	17.342		
	In FY 2006: Completed initial demonstration of an actively controlled conformal increased propulsion system performance for unmanned air vehicles. Continued d flow control devices to significantly increase and expand the separation enveloped munitions and reduce weapon bay acoustics to minimize damage to the aircraft at Mach 1. Initiated Short Take Off and Landing (STOL) Herk 1 efforts to improve capability of the AC-130 gunships.	emonstration of active or miniature speeds in excess of ift and performance						
(U)	In FY 2007: Continue development of a simulation environment to enable evaluat technologies for improved capabilities for high speed operational concepts. Contin Congressionally-directed efforts for STOL Herk 1.							
(U)	In FY 2008: Conduct flight demonstration of extensive laminar flow on swept win Complete wind tunnel testing of gust load alleviation and body freedom flutter sup altitude, long endurance platforms. Complete integration of data streams and anal user interfaces; database/model updates; validation of model and selection criteria model correction factors. Develop and integrate aircraft components that capitaliz advanced materials that are lightweight and affordable into an X-type cargo aircraft approaches that would reduce the tooling required to fabricate aircraft components demonstration efforts for an X-type cargo aircraft.	pression of high ysis tools; graphical and identification of the upon unitized t. Develop						
(U)	In FY 2009: Complete flight demonstration of extensive laminar flow on swept v Conduct and complete flight demonstration of an X-type aircraft comprised of adv weight reduction, surface smoothness, corrosion, and fatigue elimination.	U						
(U) (U)	MAJOR THRUST: Develop analytical certification methods and capability to red physical testing in the certification of structural components resulting in reduced a new systems and reduced support costs for future and legacy systems. Demonstra costs for future systems by incorporation of advanced monitoring capabilities. No	equisition cost for re reduced support	3.475	8.614	0.000	0.000		
	R-1 Lin	e Item No. 22						

	Exhibit R-2a, RDT&E Project Just	DATI	DATE February 2007					
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospa Dev/Demo			PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integration			
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) demonstration efforts real-time diagnostic and prognostics health monitoring demon being suspended because of the need for additional Applied Research efforts.	stration efforts are	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2006: Continued development and initiated demonstration of improved sustait for existing aging aircraft and future aerospace vehicle structures to reduce operation and extend usable structural lives. Continued development and initiated demonstrati diagnostic and prognostics health monitoring tools for thermal protected systems, tar subsystems to enable rapid turn around and high temperature operations of high-spec	s and support costs on of real-time iks, structures, and						
(U)	In FY 2007: Continue demonstration of improved sustainment technologies for exist and future aerospace vehicle structures to reduce operations and support costs and ex- structural lives. Continue demonstration of real-time diagnostic and prognostics hea for thermal protected systems, tanks, structures, and subsystems to enable rapid turn temperature operations.	ting aging aircraft tend usable lth monitoring tools						
(U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.							
(U) (U)	MAJOR THRUST: Develop aircraft structures that have embedded components, where the separate components that were attached to the air platforms. Note: The FY 20 increase in funding is due to the demonstration efforts related to flight testing of large embedded in a load bearing structure.	08 and out year	4.378	6.170	14.125	20.766		
(U)	In FY 2006: Continued development of multi-functional integrated structures to red support costs, weight, and volume and increase performance of air vehicles. Initiated demonstration of concepts with high multi-element antenna arrays embedded in load increase antenna performance improvement and reduced vehicle weight, cost, and vod development and initiated demonstration of concepts for very large, low frequency a embedded in the aircraft load-bearing structure to enable new antenna capabilities a performance, while reducing vehicle weight, cost, and volume.	I flight -bearing structure to olume. Continued ntenna arrays						
(U)	In FY 2007: Continue and assess results from flight demonstration of concepts with antenna arrays embedded in load-bearing structure to increase antenna performance reduced vehicle weight, cost, and volume. Continue demonstration of concepts for v frequency antenna arrays embedded in load-bearing structure to enable new antenna increased performance, while reducing vehicle weight, cost, and volume.	mprovement and ery large, low						
Pro		tem No. 22 8 of 12			Exhibit R-2a (	PE 0603211F)		
_	4	08						

Exhibit R-2a, RDT&E Pro	DATI	DATE February 2007					
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospac Dev/Demo		PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integ				
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) In FY 2008: Complete structural demonstration of low band antenna structures to reduce cost, we performance of future air platforms. Complete fabrication and flight test electronically-scanned antenna array embedded in a load-bearing structure.	ight, while improving it a large X band						
(U) In FY 2009: Complete and assess test results from the flight demonstrate electronically scanned antenna array embedded in a load-bearing structure	-						
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop adaptive structures to provide in-flight more formation and mission and flight and mission and flight.</li> </ul>		3.685	3.065	3.069	3.826		
<ul> <li>performance over a wide range of flight conditions and mission profiles</li> <li>(U) In FY 2006: Continued development and initiated demonstration of interstructures including thermal protection systems, attachments, seals, join structure, and structural health monitoring for high-speed vehicle applic and initiated+ demonstration of highly efficient wing concepts integrating concepts, adaptive structures, and aerodynamic flow control technologies and long-endurance air vehicle concepts.</li> </ul>	egrated thermal airframe ing technologies, hot primary ations. Continued development ng active aero elastic design						
<ul> <li>(U) In FY 2007: Further refine integrated thermal airframe structures include attachments, seals, joining technologies, hot primary structure, and struct high-speed vehicle applications. Continue development and demonstratic concepts integrating active aero elastic design concepts, adaptive structure control technologies to enable viable long range and long endurance air</li> </ul>	ctural health monitoring for ion of highly efficient wing ures, and aerodynamic flow						
(U) In FY 2008: Develop passive and active leading edge cooling systems f Develop and validate integration methodologies for component level lea Complete development and demonstration of highly efficient wing conc elastic design concepts.	nding edge test articles.						
(U) In FY 2009: Demonstrate passive and active thermal protection system. Assess results from demonstrations of advanced efficient wings concept design concepts and adaptive structures.							
<ul><li>(U)</li><li>(U) Total Cost</li></ul>		29.527	26.125	64.922	56.345		
	R-1 Line Item No. 22		200020		201010		

	Exhibit R-2a, RDT&E Project Justification									
BUDGET ACTIVITY 03 Advanced Technology Deve	lopment (ATD	))		0603	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo			PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integration		
(U) <u>C. Other Program Funding S</u>	ummary (\$ in N	<u>(Iillions)</u>								
	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	FY 2011 Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u> <u>Total Cost</u>	
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602201F, Aerospace Vehicle Technologies.</li> <li>(U) PE 0604015F, Next Generation Bomber.</li> <li>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</li> </ul>										
(U) <u>D. Acquisition Strategy</u> Not Applicable.										
Project 4920				R-1 Line Item No. Page-10 of 12					Exhibit R-2a (PE 0603211F)	
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		Exhibit R-	2a, RDT&I	E Project	Justificati	on			DATE	February 2	2007
		ent (ATD)			06032	11F Aerosp		ogy 99	ROJECT NUMBE SP Advance chicles	R AND TITLE	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
99SP	Advanced Technology Development (ATD)       0603211F Aerospace Technology Dev/Demo       9         Cost (\$ in Millions)       FY 2006 Actual       FY 2007 Estimate       FY 2008 Estimate       FY 2010 Estimate       FY 2011 Estimate       FY 2011 Estima			Continuing	TBD						
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
Projec 6399S (U) <u>4</u>	et 635062, Advanced Structures for Sp P were transferred into Project 4920 A. Mission Description and Budget This project identifies, develops, and opperability, responsiveness, and cost-	pace Vehicles, within this PE Item Justifica demonstrates t effectiveness.	in order to eff , as the planne tion he technologie Enabling tech	fectively man ed efforts wer es to enable ad nologies inclu	age and provid re not space un dvanced acces ude thermal pr	le oversight of ique. s-to-space aer otection, struc	f the efforts. I ospace vehicle tures, vehicle	n FY 2008, these sthat deliver	e remaining et	fforts in Project	ct
(U) (U) (U) (U) (U)	MAJOR THRUST: Develop the airfi of reusable high altitude aerospace ve In FY 2006: Not Applicable. In FY 2007: Continue developing the generation reusable access to space sy and vehicle and payload system techn capability, operability, responsiveness In FY 2008: Not Applicable.	ame and payle hicles. e airframe and ystems includin hologies that en	payload technologi payload techn ng the thermal nable aerospac	ologies requi	red to enable r tructural, conf	next iguration,		_	<u>Y 2007</u> 2.789	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U)	Total Cost						0.0	00	2.789	0.000	0.000
(U)	C. Other Program Funding Summa	ry (\$ in Millio	ons)								
(U) I (U) 7	E 0602201F, Aerospace Vehicle Technology This project has been	<u>Y 2006</u> <u>F</u>	<u>Y 2007</u> <u>F</u>						FY 2013 Estimate	<u>Cost to</u> Complete	<u>Total Cost</u>
Proje	ect 99SP				Line Item No. 2 Page-11 of 12 <b>411</b>	2				Exhibit R-2a (P	E 0603211F)

Exhibit R-2a, RDT&E Pr	roject Justification		DATE February 2007		
JDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER AND TITLE 99SP Advanced Structures Vehicles			
(J) <u>C. Other Program Funding Summary (\$ in Millions)</u>					
Reliance process to harmonize efforts and eliminate duplication.					
<ul> <li>D. Acquisition Strategy</li> <li>Not Applicable.</li> </ul>					
Project 99SP	R-1 Line Item No. 22 Page-12 of 12		Exhibit R-2a (PE 0603211		

#### PE NUMBER: 0603216F PE TITLE: Aerospace Propulsion and Power Technology

	Ex	hibit R-2,	RDT&E B	udget Item	n Justifica	tion			DATE	February 2	2007
	T ACTIVITY <b>/anced Technology Developme</b>	ent (ATD)				IBER AND TITL <b>16F Aerospa</b>		on and Pow	er Technolo	gy	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	98.901	145.891	117.990	163.066	204.549	189.899	128.513	131.258	Continuing	TBD
10SP	Space Rocket Prop Demo	0.000	27.753	27.905	31.536	39.889	40.680	38.439	38.835	0.000	0.000
2480	Aerospace Fuels	5.187	9.432	7.524	12.177	12.658	10.776	8.523	8.654	Continuing	TBD
3035	Aerospace Power Technology	8.391	14.198	5.975	4.496	4.664	4.742	4.843	4.961	Continuing	TBD
4921	Aircraft Propulsion Subsystems Int	31.996	27.729	16.459	31.950	43.207	55.598	18.555	19.146	Continuing	TBD
4922	Space & Missile Rocket Propulsion	7.713	4.821	4.734	5.138	5.331	5.422	5.535	5.673	Continuing	TBD
5098	Advanced Aerospace Propulsion	22.187	34.036	21.886	23.233	24.606	24.513	23.567	24.125	Continuing	TBD
681B	Advanced Turbine Engine Gas Generator	23.427	27.922	33.507	54.536	74.194	48.168	29.051	29.864	Continuing	TBD

Note: In FY 2006-2007, a portion of the funding in Projects 2480 and 4921 was shifted to Project 5098. In FY 2007, Project 10SP, Space Rocket Propulsion Demonstration, was transferred from PE 0603500F, Multi-Disciplinary Advanced Development Space Technology, Project 5033, Rocket Propulsion Demonstration, in order to more effectively manage and provide oversight of the efforts. The funding in this PE has been increased due to emphasis on component development in support of adaptive cycle technologies, alternative hydrocarbon jet fuel, improved fuel efficiency, highly efficient embedded turbine engines, and small heavy fueled engines.

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

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced cycle, and rocket propulsion, as well as electrical power thermal management, and fuels. The program has seven projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapons systems. The Aerospace Fuels and Atmospheric Propulsion project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for high-speed/hypersonic flight. The Aerospace Power Technologies project develops and demonstrates power and thermal management systems for weapons and aircraft. The Advanced Turbine Engine Gas Generator (ATEGG) project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. The Aerospace Propulsion Subsystem Integration (APSI) project integrates the engine cores demonstrated in the ATEGG project with low-pressure components into demonstrator engines. Turbine engine propulsion projects within this program are part of the Versatile Affordable Advanced Turbine Engine program. A portion of the Fuels, ATEGG, and APSI projects supports adaptive cycle technology demonstrations which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs. The Advanced Aerospace Propulsion project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. The Space and Missile Rocket Technology project develops and demonstrates advanced and innovative low-cost rocket turbomachinery and components, low-cost space launch propulsion system technologies, and advanced propellants for launch and orbit transfer propulsion. Rocket propulsion projects within this program are part of the Integrated High Payoff Rocket

Exhibit R-2 (PE 0603216F)

	Exhibit R-2, RDT&E B	udget Item Justification		DATE Februa	ry 2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace	Propulsion and Power T	echnology	-
	Propulsion Technology (IHPRPT) program, which includes the at \$4.6 million for Assured Fuels Process Demonstration Unit; \$2.0 Wafer-Cell Ni-MH Battery; \$1.0 million for Field Renewable End More Electric Aircraft; \$5.5 million for Accelerated VAATE Adv Advanced Turbine Engine Program; and \$2.2 million for Versatile Technology Development, since it develops and demonstrates tech and address warfighter needs.	million for Flexible JP-8 Military Fuel Certific ergy System Hydride Li Ion Battery Program; S v Supersonic Cruise Missile Engine; \$8.0 millio e Affordable Advanced Turbine Engines. This	ation; \$1.0 million for Deve 66.6 million for Silicon Carb on for XTC58F Technology program is in Budget Activi	elopment of Bi-Pola bide Power Electron Versatile Affordabl ity 3, Advanced	r ics for le
(U)	<b>B. Program Change Summary (\$ in Millions)</b>				
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Previous President's Budget	97.163	115.546	119.310	128.770
(U)	Current PBR/President's Budget	98.901	145.891	117.990	163.066
(U)	5	1.738	0.000		
(U)	e e	0.000	-0.002		
	Congressional Rescissions	-0.003	-0.553		
	Congressional Increases	4 117	32.900 -2.000		
	Reprogrammings SBIR/STTR Transfer	4.117 -2.376	-2.000		
(U)	Significant Program Changes:	-2.370			
(0)	Not Applicable.				
	C. Performance Metrics				
	(U) Under Development.				
		R-1 Line Item No. 23 Page-2 of 31		Exhibit R-	2 (PE 0603216F)
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		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			Γ		February	2007
	<ul> <li>MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch</li> <li>MAJOR THRUST: Develop liquid rocket propulsion technology for current and future space launch</li> <li>In FY 2006: Not Applicable.</li> <li>In FY 2007: Completed testing of advanced lightweight thrust chamber and nozzle technologies. Scaled-up advanced cryogenic upper stage technologies including higher efficiency energy conversion systems. Completed hardware design for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. Studied advanced hydrocarbon engine technologies for future reusable launch vehicles.</li> <li>In FY 2008: Begin hardware fabrication for advanced cryogenic upper stage technologies - turbopumps and thrust chambers. These components will be used to validate modeling, simulation, and analysis tools being developed. Begin preparations for testing of these components. Start component and engine</li> </ul>									Demo		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010		FY 2012	2 FY 2	2013	Cost to	Total	
	``````````````````````````````````````											
10SP								38.4	1		0.000	0.000
Nutri		÷	•	÷	, , , , , , , , , , , , , , , , , , ,	ů	*		Ŷ	Ŷ		Duringt
			-	-	Power Techno	llogy, Project	5055, Space F	Cocket Pro	puision De	emonst	ration, to this	Project
S C P Li a a b m t	systems Phase 1. Characteristics such osts are emphasized. Increased life a ropulsion technologies for station-ke ightweight, advanced propulsion tech nd high-energy propellants. Technol pproximately 20 percent, and reduce e enhanced for reusable launch system naneuvering capability, a 25 percent to the Integrated High Payoff Rocket 1	as environme and performance eping and on- nologies, high ogical advanc launch, opera- ms. Technolo reduction in of Propulsion Tec	ental acceptabilities ce of propulsic orbit maneuve her efficiency e es developed i tions, and supp gy advances c bit transfer op chnology prog	lity, affordab on systems are ring application energy conver in this program port costs by a ould also lead perational cost ram (IHPRP1	ility, reliability e key goals. T ons. Technolo rsion systems ( m could impro- approximately 1 to seven-year ts, and a 15 per (), a joint Depa	y, responsivent his project also gy areas invest derived from a ve the perform 30 percent. R increase in sa rcent increase	ess, reduced v o develops ch stigated includ an improved u nance of exper esponsiveness itellite on-orbi in satellite pag	veight, and emical, ele le ground c inderstandi ndable pay s and opera it time, a 50 yload. The	reduced o actrical, and lemonstrat long of com load capab ability of p 0 percent i e efforts in	peratic d solar ions of bustion ilities ropuls: ncrease this pr	on and launch rocket f compact, n fundamenta by ion systems w e in satellite roject contribu	ls), vill ute
(U) <u>]</u>	3. Accomplishments/Planned Prog	<u>ram (\$ in Mill</u>	lions)				<u>FY 20</u>	06	<u>FY 2007</u>		<u>FY 2008</u>	<u>FY 2009</u>
		ocket propulsi	on technology	for current an	nd future space	launch	0.0	00	21.202		22.486	25.877
(U) I (U) I S s t	n FY 2006: Not Applicable. n FY 2007: Completed testing of ad- Scaled-up advanced cryogenic upper systems. Completed hardware design hrust chambers. Studied advanced h	stage technolo for advanced	gies including cryogenic upp	higher efficie er stage techn	ency energy co ologies - turbo	onversion opumps and						
٤ t	and thrust chambers. These compone	ents will be use ations for testin	ed to validate r	nodeling, sim nponents. Sta	nulation, and an art component	nalysis and engine						
Proje	ct 10SP			R-1	Line Item No. 2 Page-3 of 31 415	3					Exhibit R-2a (I	PE 0603216F)

	Exhibit R-2a, RDT&E Project Just	ification	DA	TE February 2	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology		UMBER AND TITLE ce Rocket Prop I	Demo
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> advanced manufacturing technology demo aimed at materials and processes to support engine technology development effort. Initiate advanced hydrocarbon fuels scale-up advanced hydrocarbons as fuels or additives to rocket engine fuels and for potential to reusable launch vehicles.	effort to prove out	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Complete advanced cryogenic upper stage hardware fabrication and beac components to validate and verify modeling and simulation tools developed. Developed engine components for integration and demonstration in an advanced hydrocarbon enfuture reusable launch vehicles. Continue material manufacturing scale-up effort to a hydrocarbon boost demonstration program. Continue advanced hydrocarbon fuel/ad proof efforts.	p hydrocarbon ngine concept for support			
(U) (U)	MAJOR THRUST: Develop solar electric propulsion technologies for existing and f	uture satellites, 0.000	5.354	4.345	3.787
(U) (U) (U)	<ul> <li>upper stages, orbit transfer vehicles, and satellite formation flying, station keeping, a</li> <li>In FY 2006: Not Applicable.</li> <li>In FY 2007: Continue development of electric propulsion systems for orbit-transfer</li> <li>high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit trans</li> <li>component integration for the high-power Hall thruster demonstration. Complete tes</li> <li>advanced small satellite propulsion demonstration unit for a microsatellite demonstrat</li> <li>flight of propulsive attitude control system on microsatellite demonstration. Initiate h</li> <li>for an advanced multi-mode (high thrust or high efficiency) propulsion system for sat</li> <li>development of satellite sensors to analyze satellite thruster interactions.</li> <li>In FY 2008: Continue development of electric propulsion systems for orbit-transfer</li> <li>high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit trans</li> <li>component integration for the high-power Hall thruster interactions.</li> <li>In FY 2008: Continue development of electric propulsion systems for orbit-transfer</li> <li>high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit trans</li> <li>component integration for the high-power Hall thruster demonstration. Continue har</li> <li>an advanced multi-mode (high thrust or high efficiency) propulsion system for satellit</li> <li>development of satellite sensors to analyze satellite thruster interactions.</li> <li>In FY2009: Continue development of electric propulsion systems for orbit-transfer b</li> <li>high-power Hall thrusters capable of Low Earth Orbit to Geosynchronous Orbit trans</li> </ul>	nd repositioning. by developing fer. Begin t flight of the tion. Support test aardware scale-up tellites. Continue by developing fer. Continue dware scale-up for tes. Complete y developing			5.107
	complete testing of the high-power Hall thruster demonstration. Continue hardware advanced multi-mode (high thrust or high efficiency) propulsion system for satellites demonstration of advanced chemical propulsion system for satellites.	scale-up for an			
Pro		tem No. 23 4 of 31		Exhibit R-2a (PI	E 0603216F)
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		Exhibit	: R-2a, RD	Γ&E Projec	t Justifica	tion			DATE	February	2007
	ET ACTIVITY dvanced Technology Dev	elopment (ATD	)		0603	JMBER AND TI 216F Aeros er Technolo	pace Propuls	ion and	PROJECT NUMBI	ER AND TITLE	
	<b>B.</b> Accomplishments/Planne	ed Program (\$ in	<u>Millions)</u>				<u>FY 20</u>	<u>)06</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
J) J)	MAJOR THRUST: Develop technologies for future satelli In FY 2006: Not Applicable. In FY 2007: Initiate develop development of Phase II mon In FY 2008: Continue develo In FY 2009: Continue develo	te propulsion syste ment of an advanc opropellant thruste opment of an adva	ems. Phases an ed Phase III m er technologies nced Phase III	re referring to I onopropellant s. monopropellar	HPRPT progra thruster and co nt thruster.	ım phases. mplete	0.0	000	1.197	1.074	1.872
	Total Cost	•				C	0.0	000	27.753	27.905	31.536
1 (1 1) 1	C. Other Program Funding Not Applicable. D. Acquisition Strategy Not Applicable.	<u>Summary (\$ in M</u> <u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	FY 2008 Estimate	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimat</u>		<u>Cost to</u> <u>Complete</u>	Total Cost
				-	R-1 Line Item No						

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
		ent (ATD)			06032 <sup>-</sup>	16F Aerospa	ace Propulsi				
Exhibit R-2a, RD1& Project Justification         February 2007           BUDGET ACTIVITY         O3 Advanced Technology Development (ATD)         Project Justification         Project NUMBER AND TITLE         OG03216F Aerospace Propulsion and Dower Technology         PROJECT NUMBER AND TITLE 2480 Aerospace Fuels         PROJECT NUMBER AND TITLE 2603216F Aerospace Propulsion and Dower Technology         PROJECT NUMBER AND TITLE 2480 Aerospace Fuels         5.187 9.432         7.524         12.177 12.658         10.776         8.523         8.654         Continuing           2480 Aerospace Fuels         5.187         9.432         7.524         12.177         12.658         10.776         8.523         8.654         Continuing         7           Quantity of RDT&E Articles         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0						Total					
	· · ·						1			1	
2480										Continuing	TBD
Nota		ş	ő	÷	Ŷ	ů	ţ	ş	ţ	des soeh on ist	fuel and
	Exhibit K-22, RD1&E Project JUSUITCATION         February 2007           SUDGET ACTIVITY         SUDGET ACTIVITY         PROJECT NUMBER AND TITLE         Cost (\$ in Millions)         FY 2007         FY 2007         FY 2007         FY 2010         FY 2011         FY 2012         FY 2013         Cost (\$ in Millions)         FY 2007         FY 2007         FY 2007         FY 2010         FY 2011         FY 2013         Cost (\$ in Millions)         FY 2007         FY 2008         FY 2010         FY 2011         FY 2013         Cost (\$ in Millions)         FY 2007         FY 2010         FY 2011         FY 2013         Cost (\$ in Millions)         A develop and the million of the omphasis on component development in support of adaptive cycle technologies, alternative hydrocarbon jet fuel, and proved fuel difficancy.           VI MASISION Description and Budget Item Justification         The funding in this project tab been increased due to emphasis is on developing and demonstrates inproved fuel difficancy.         The funding inclusion systems. The project also develops and demonstrates improved fuel difficancy and indicarbon truthic based combined cycle regines. This project further advanced propulsion and domonstrate is conc		ruer, and								
	This project develops and demonstrate high-speed/hypersonic flight and techn fuel consumption, and cost of ownersh chemically reacting fuels for a conven develops and demonstrates fuel system propulsion emphasis is on demonstrate Advanced Turbine Engine program. A	es improved hy nology to incre- nip. The adva- tional turbine n components ing concepts for portion of this	vdrocarbon fue ease turbine er inced fuel emp engine, turbin that minimize or combined c s project supp	ngine operatio hasis is on de e-based comb cost, reduce ycle, ramjet, a orts the demo	onal reliability, eveloping and c bined cycle eng maintenance, a and scramjet en onstration of ad	durability, midemonstrating gines, and other and improve p ngines. This p laptive cycle to	ission flexibili new thermall ar advanced pr erformance of project is integ echnologies. T	ty, and perfor y stable, high- opulsion syste future aerosp rated into the Chis project de	mance while r -heat sink, and ems. The proj pace systems. Versatile Affe evelops compo	educing weig l controlled ect also The advanced ordable	
(U) (U)	MAJOR THRUST: Demonstrate ther cooling capacity (performance), minin develop, and demonstrate technologie needs. Determine fuel cooling require Design, fabricate, and test key therma cooling air systems, and high tempera Note: In FY 2006 and FY 2007, fund priorities in Project 5098, Advanced A development of this effort. Increased development in support of alternative to emphasis on component development In FY 2006: Studied, tested, and dem including those produced from alternative	rmally stable f mize fuel coking so that enable t ements and spul anagement ature/thermally ling from this a Aerospace Pro- funding in FY hydrocarbon j ent in support constrated at a ative energy re	uels and fuel s ng, and reduce he use of dom ecifications fo technologies, efficient fuel Project was me pulsion, in this 2008 and out et fuel. Incre of adaptive cy pilot-light leve sources and ha	e fuel system i estic fuel sour r an adaptive including hig pumps for mi oved to suppo s PE. Funding due to empha ased funding cle technolog el, advanced h ardware conce	maintenance. I rces for militar cycle engine a gh heat sink fue ission adaptive ort higher Air F g shift caused o sis on compon in FY 2009 an ies. high heat sink fue	Identify, y energy rchitecture. els, cooled e engines. Force delay in tent id out due fuels icrease					
		· •	aer system du	raonny, and I	cauce mannen						
(U)	In FY 2007: Continue to study, test, a	and demonstra	te, advanced h	igh heat sink	fuels including	g those					
Proje	ect 2480				Line Item No. 23 Page-6 of 31	3				Exhibit R-2a (P	E 0603216F)
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	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Power Technology	Propulsion and	PROJECT NUM 2480 Aerosp		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> produced from alternative energy resources and hardware concepts that can increase at high temperatures, improve fuel system durability, and reduce maintenance due to aircraft and engine hardware. Initiate demonstrations of fuel performance at fuel ten supercritical regime.	fuel degradation in apperatures in the	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Continue demonstrations of fuel combustion performance at fuel temper supercritical regime, as might be encountered in an engine employing a cooled coolin Demonstrate engine durability benefits from the use of alternative fuels. Develop re- alternate fuel composition and key properties, including low temperature viscosity an stability. Improve physical property models for alternative fuels. Develop relationsh fuel/material interactions and fuel (and material) structure.	ng air system. lationship between nd thermal/storage nip between				
(U)	In FY 2009: Continue demonstration of engine and airframe durability and performative use of alternative fuels. Continue development of knowledge base needed for Air certification of alternative fuels, especially biofuels. Continue demonstration of coordsystems and other advanced aircraft thermal management systems. Determine fuels required to increase specific gravity to 0.775. Determine elastomer swell agents cap swell to typical JP-8 levels. Begin determination of new specification requirements alternative fuels. Develop key thermal management technologies, including high her cooling air systems, and high temperature/thermally efficient fuel pumps.	r Force-wide led cooling air tructure changes able of increasing for biomass-derived				
(U) (U) (U)	MAJOR THRUST: Determine fuel cooling requirements and specifications for advases sensors and directed energy weapons that will meet the needs of evolving manned sy unmanned aerial vehicle (UAVs). Note: In FY 2006 and FY 2007, funding from this moved to support higher Air Force priorities in Project 5098, Advanced Aerospace FPE. Funding shift caused delay in development of this effort. In FY 2006: Studied, tested, and demonstrated at a pilot-light level advanced fuels f applications including advanced low temperature fuels and fuels to enable extended at a statement.	rstems and s Project was Propulsion, in this or UAV	0.025	0.506	1.000	2.000
(U)	In FY 2007: Demonstrate advanced low temperature and enhanced performance fue applications focusing on technologies that expand the flight envelope, range, or dura include advanced thermal management concepts.	ls for UAV tion of UAVs to				
(U)	In FY 2008: Continue to demonstrate advanced low temperature and enhanced performance uAV applications and the Highly Efficient Embedded Turbine Engine (HEETE), for					
Pro	ject 2480 Page	tem No. 23 -7 of 31 <b>19</b>			Exhibit R-2a (I	PE 0603216F)

	Exhibit R-2a, RDT&E Project J	ustification		DA	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospac Power Technology			IMBER AND TITLE space Fuels	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> thermal management technologies that expand the flight envelope, range, or dura In FY 2009: Demonstrate an advanced UAV/HEETE thermal management syste cooled cooling air system, as well as advanced approaches for ensuring fuel flow high altitude, long endurance conditions.	em that includes a	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop and demonstrate efficacy of low-cost, environment additives to reduce soot particulate emissions from gas turbine engines using adv combustors and small turbine engines. Note: In FY 2006 and FY 2007, funding moved to support higher Air Force priorities in Project 5098, Advanced Aerospa PE. Funding shift caused delay in development of this effort. In FY 2006: Demonstrated at a pilot-light level fuel additives that reduce soot en	ranced research from this Project was ce Propulsion, in this	0.025	0.506	1.000	1.183
(U)	percent. In FY 2007: Demonstrate advanced additives to reduce soot and nitrogen oxides propulsion concepts including combined cycle engines.	emissions in advanced				
(U)	In FY 2008: Demonstrate advanced particulate measurement diagnostics suitabl testing. Initiate demonstration of fuel/combustor concepts that reduce both soot	-				
(U)	In FY 2009: Continue to demonstrate advanced particulate measurement diagno full-scale engine testing. Continue demonstration of fuel/combustor concepts tha NOx.	stics suitable for				
(U) (U)	MAJOR THRUST: Develop and demonstrate enhancements to fuel system tech	nology Note: In FY	0.025	0.340	1.000	1.000
(0)	2006 and FY 2007, funding from this Project was moved to support higher Air F Project 5098, Advanced Aerospace Propulsion, in this PE. Funding shift caused of this effort.	orce priorities in	0.025	0.540	1.000	1.000
(U)	In FY 2006: Designed and developed at a pilot-light level hardware and fuel system components of reusable aerospace vel aerospace vehicles with advanced and combined cycle engines that require high	nicles focusing on				
(U)	In FY 2007: Continue design, development, and demonstration of hardware and to evaluate key high temperature fuel system components of reusable aerospace aerospace vehicles with advanced and combined cycle engines that require high	fuel system simulators vehicles focusing on				
(U)	In FY 2008: Develop combined cycle engine cooling systems, utilizing 2nd-gen	•				
Proj		ine Item No. 23 age-8 of 31			Exhibit R-2a (I	PE 0603216F)

	Exhibit R-2a, RDT&E Project Just	ification		[	DATE February 2007				
	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propul Power Technology	sion and		NUMBER AND TITLE rospace Fuels				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>	FY	2006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
	fuels and other advanced fuels.								
(U)	In FY 2009: Continue development and demonstration of combined cycle engine co	oling systems and							
	technologies utilizing 2nd-generation endothermic fuels and other advanced fuels.								
(U) (U)	MAJOR THRUST: Identify, develop, and demonstrate low-cost approaches to reduc	ing the fuel	.087	0.505	0.524	1.000			
(0)	logistics footprint for the Expeditionary Air Force. Note: In FY 2006 and FY 2007,	-	.087	0.505	0.524	1.000			
	Project was moved to support higher Air Force priorities in Project 5098, Advanced	•							
	Propulsion, in this PE. Funding shift caused delay in development of this effort.								
(U)	In FY 2006: Developed at a pilot-light level novel methods including bio- and nano-	technology for fuel							
	analysis.								
(U)	In FY 2007: Demonstrate advanced nano-technology fuel additives, nano-technology	y fuel sensors, and							
	novel detection and mitigation technologies for biological growth.								
(U)	In FY 2008: Develop model for growth and spread of biological materials through for	•							
	systems. Continue to demonstrate advanced nano-technology fuel additives, nano-te	chnology fuel							
	sensors, and novel detection and mitigation technologies for biological growth.	11.							
(0)	In FY 2009: Develop ability to model spread of biological materials through fuel has Initiate demonstration of advanced additives to mitigate biological growth in convent	<b>.</b> .							
	alternative aerospace fuels.								
(U)	anomative derospace rueis.								
(U)	MAJOR THRUST: Characterize and demonstrate the use of alternative hydrocarbon	i jet fuel to comply 5	.000	0.000	0.000	0.000			
Ì,	with Air Force certifications and standards for jet fuels. Note: Funding increase in F								
	emphasis on component development in support of alternative hydrocarbon jet fuel.								
(U)	In FY 2006: Demonstration of alternative hydrocarbon jet fuel derived from natural								
	Fischer-Tropsch (FT) process. This is a blend of conventional JP-8 and FT alternative								
	through material testing, engine ground testing, and flight testing in two of eight engine	ines in a B-52.							
	In FY 2007: Not Applicable.								
(U)	In FY 2008: Not Applicable.								
	In FY 2009: Not Applicable.								
(U) (U)	CONGRESSIONAL ADD: Assured Fuels Process Demonstration Unit.	0	.000	4.583	0.000	0.000			
· /	In FY 2006: Not Applicable.	Ū		1.505	0.000	0.000			
ľ									
Pro		tem No. 23 9 of 31			Exhibit R-2a (F	PE 0603216F)			
1.10		21				_ 00002101 )			

	Exhibit	R-2a, RD	F&E Projec	t Justificat	tion			DATE	February	2007	
BUDGET ACTIVITY 03 Advanced Technology Develo	opment (ATD)	)		0603					DJECT NUMBER AND TITLE 80 Aerospace Fuels		
(U) <b>B. Accomplishments/Planned P</b>			······		l	<u>FY 20</u>	<u>06</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2007: Develop capability processes and resulting fuel prop- jet fuel properties.	-	-		•							
(U) In FY 2008: Not Applicable.											
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>											
(U) CONGRESSIONAL ADD: Flex	tible JP-8 Milit	arv Fuel Certi	fication.			0.0	00	1.992	0.000	0.000	
(U) In FY 2006: Not Applicable.		,									
(U) In FY 2007: Support development					fuels for Air						
Force systems. Procure and test	non-petroleum	fuels as requi	red for certifica	ation.							
(U) In FY 2008: Not Applicable.											
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U) Total Cost</li></ul>						5.1	87	9.432	7.524	12.177	
、 <i>′</i>	( <b>†</b> • • •					011		<i>y</i>	, 10 - 1		
(U) <u>C. Other Program Funding Sun</u>	•		<b>EV 2000</b>	EV 2000	<b>EV 2010</b>	FN/ 0011	EX 0010	EX 2012			
	<u>FY 2006</u> Actual	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> <u>Estimate</u>	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimat</u>			Total Cost	
(U) Related Activities:	<u>r tetuar</u>	<u>Listimate</u>	Listinute	Limate	Listinute	Estimate	Listimat	<u>e Estimat</u>		ź	
(U) PE 0602203F, Aerospace											
Propulsion.											
(U) PE 0602102F, Materials.											
(U) PE 0602204F, Aerospace Sensors.											
(U) PE 0603112F, Advanced											
Materials for Weapons											
Systems.											
(U) This project has been											
coordinated through the											
Reliance 21 process to harmonize efforts and											
eliminate duplication.											
			I	R-1 Line Item No.	. 23						
Project 2480				Page-10 of 31					Exhibit R-2a (	PE 0603216E)	

Exhibit R-2a, RDT&E	DATE February 2007				
DGET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJEC 2480 A	ROJECT NUMBER AND TITLE 480 Aerospace Fuels		
D. Acquisition Strategy					
Not Applicable.					
roject 2480	R-1 Line Item No. 23 Page-11 of 31		Exhibit R-2a (PE 06032		

								DATE February 2007			
									PROJECT NUMBER AND TITLE 3035 Aerospace Power Technology		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	2 FY 2013	Cost to	Total
	·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate			
3035		8.391	14.198	5.975	4.496	4.664	4.742	4.84			TBD
(U)	Quantity of RDT&E Articles	0	0	0	0	0	0		0	0	
(U) (U)	A. Mission Description and Budget This project develops and demonstrate survivability, and reduces vulnerabilit developed are projected to provide a t This project also develops and demon energy weapons. B. Accomplishments/Planned Progr MAJOR THRUST: Develop electrica technologies for integration with direct delivery of high power for operation of system demonstration activity will be	es electrical po y, weight, and wo- to five-fol strates electric cam (\$ in Mill al power and the cted energy we of DEW. Note	wer, thermal i life cycle cosi d improvement al power and t ions) hermal manage eapons (DEW) :: In FY 2006	s for manned at in aircraft re hermal manage ement compo- b. These technologies, the megawat	and unmanned eliability and r gement techno nent subsystem nologies will e tt superconduc	d aerospace ve naintainability logies to enab n n nable the ting power	chicles. The e	lectrical po cent reduct high power 06	wer system co tion in power s	omponents system weight.	nd <u>FY 2009</u> 0.000
(U) (U) (U)	activity in FY 2009. In FY 2006: Developed technology r an airframe as part of a non-lethal we non-superconducting low duty cycle g In FY 2007: Complete design and pe non-superconducting low duty cycle g In FY 2008: Perform test of high pow In FY 2009: Not Applicable.	oadmaps and o apon system. generator syste rform modelin generator syste	completed ana Completed ini em tailored to g and simulat em tailored to	lysis of power tial design of directed energ ton of a mega directed energ	r system integr a megawatt gy weapons. watt gy weapons.	ration into					
(U) (U)	MAJOR THRUST: Develop power g and thermal management components high power aircraft. These technolog maintainability, supportability, and sy enabling new capabilities. Note: In starting again in FY 2009. In FY 2006: Completed engine integ- engines.	s and subsyster ies will impro- ystem weight/v FY 2006, acti	n technologies ve aircraft self colume ratios, vities were co	s for integration- -sufficiency, 1 while reducin mpleted, with	on into current reliability, ng life cycle co n follow-on effe	and future sts and orts	1.1	90	0.000	0.000	1.450
	ect 3035				Line Item No. 2 Page-12 of 31 424	3				Exhibit R-2a (P	E 0603216F)

	Exhibit R-2a, RDT&E Project Ju	stification		DAT	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospac Power Technology	e Propulsion and		MBER AND TITLE pace Power T	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Begin design of high temperature demonstrator and fabrication of ke	y components.				
(U)	MAJOR THRUST: Develop electrical power and thermal management component technologies for special purpose applications. Note: In FY 2006, funding for this within this Project to support multi-megawatt superconducting activities. Efforts we delayed until FY 2007. In FY 2008, this activity will be completed.	thrust was shifted	0.000	1.442	2.273	0.000
	In FY 2006: Not Applicable.					
(U) (U)	In FY 2007: Investigate alternative energy storage/generation systems for low pow In FY 2008: Develop and fabricate high power density and high energy density fur energy storage and power and thermal management/distribution components and s for field tests to demonstrate a 50% weight reduction.	el cell and battery				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	MAJOR THRUST: Develop analytical tools and subsystems for multi-megawatt selectrical power systems including power generation, conditioning, thermal manage interaction.		1.656	3.272	3.488	3.046
(U)	In FY 2006: Completed preliminary design for a megawatt class power demonstra					
(U)	In FY 2007: Begin detailed design of megawatt class power demonstrator and beg components.	in fabrication of key				
(U)	In FY 2008: Design and fabricate multi-megawatt superconducting power and the components.	rmal management				
(U)	In FY 2009: Integrate and begin demonstration testing of multi-megawatt superconthermal management.	nducting power and				
(U)	C C C C C C C C C C C C C C C C C C C					
(U)	CONGRESSIONAL ADD: Advanced Satellite Thermal Control Program.		1.635	0.000	0.000	0.000
(U)	In FY 2006: Developed electrochromic coatings (EC's) and prepared them for qua Navy's Mid-Star micro-satellite, specifically addressing the electrode connection b					
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
	R-1 Lin	e Item No. 23				
		e-13 of 31			Exhibit R-2a (	

Propulsion and <u>FY 2006</u> 2.019 0.962		MBER AND TITLE pace Power To <u>FY 2008</u> 0.000	
2.019			
	0.000	0.000	0.000
	0.000	0.000	0.000
0.962			
0.962			
0.962			
0.962			
0.962			
	0.996	0.000	0.000
0.000	0.996	0.000	0.000
0.000	6.575	0.000	0.000
		Exhibit R-2a (I	PE 0603216F)
	0.000	0.000 0.996	0.000 0.996 0.000

	Exhibi	t R-2a, RD	C&E Projec	t Justificat	tion			DATE	February	2007		
BUDGET ACTIVITY <b>3 Advanced Technology Devel</b>	opment (ATD	))		0603	UMBER AND TI 3216F Aeros er Technolog	pace Propuls			ECT NUMBER AND TITLE Aerospace Power Technology			
<ul> <li>U) <u>B. Accomplishments/Planned</u></li> <li>U) In FY 2009: Not Applicable.</li> <li>U) Total Cost</li> </ul>	Program (\$ in	<u>Millions)</u>				<u>FY 20</u> 8.3	<u>006</u> 391	<u>FY 2007</u> 14.198	<u>FY 2008</u> 5.975	<u>FY 2009</u> 4.496		
<ul> <li>(U) C. Other Program Funding Su</li> <li>(U) Related Activities:</li> <li>(U) PE 0602201F, Aerospace Flight Dynamics.</li> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0602605F, Directed Energy Technology.</li> <li>(U) PE 0603605F, Advanced Weapons Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>	ummary (\$ in M <u>FY 2006</u> <u>Actual</u>	Millions) FY 2007 Estimate	FY 2008 Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimat		Cost to Complete	I OLAI COS		
Project 3035			I	R-1 Line Item No. Page-15 of 31					Exhibit R-2a (	PE 0603216F		

		Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on			DATE	February	2007
	ET ACTIVITY Ivanced Technology Developme	ent (ATD)			06032 <sup>-</sup>	IBER AND TITL 16F Aerospa Technology	ace Propulsi	ion and 49	ROJECT NUMBE 121 Aircraft F 11 ubsystems I	Propulsion	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4921	Aircraft Propulsion Subsystems Int	31.996	27.729	16.459	31.950	43.207	55.598	18.555	19.146	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
Note:	The funding in this project has been	increased due	to emphasis o	n component	development i	n support of a	daptive cycle	technologies.			
v d V C A A n h c r r r p a a p n c c e	This project develops and demonstrated weight, fuel consumption, and cost of lemonstrator engines such as the Joint rehicle and cruise missile applications Gas Generator project with the engine Additionally, these efforts include acti- tozzles, engine/airframe compatibility igher cruise speeds with lower specifi- ost, and improved survivability, resul- esponsive space launch. APSI suppo- propulsion capabilities while at the sam pproximately twice the range for a su- propulsion for a high speed supersonic inilitary turbine engine upgrades and co- ompetitiveness. A portion of this pro- ngine architecture that provides optim	ownership. T t Technology I s. The demons e (low-pressure ivities under the y, and power as fic fuel consum lting in increase orts the goals of me time reduct istained supers c missile with derivatives, and pject supports to nized performation	his project inc Demonstrator strator engines e spool) techno ne national Pro- nd thermal man ption, surge p sed mission eff f the national V ing the cost of sonic combat a double the rand d have the add the demonstra ance, fuel effic	ludes the Aer Engine for ma integrate the ology such as opulsion Safet magement sub ower for succ fectiveness. T Versatile Affo ownership. aircraft, doubl- age for time se led dual-use b tion of adaptiv	ospace Propuls anned systems core (high-pre fans, turbines, y And Readine osystems techn cessful engager Technologies d ordable Advane Anticipated technologies d ing the time or ensitive targets enefit of enhance	sion Subsyster and the Joint essure spool) to engine contro ess (PSAR) pr tologies. APS ments, high so leveloped are a ced Turbine E chnology adva n station with . The VAATI noing the Unit ologies, which	ms Integration Expendable T echnology devols, mechanica ogram. This p I provides airco ortie rates with applicable to s ngine (VAAT ances include 10 times the p E program pro- ed States turbin develop com	(APSI) program veloped under l systems, exh project also for craft with pote reduced main sustained high E) program, ver turbine engine ower output for vides continue ine engine incorponent technologies	ram, which inc e Concept for the Advanced haust nozzles, ocuses on integ ential for longe ntenance, redu n-speed vehicle which is focuse e improvemen for surveillance ious technolog dustry's interna	Eludes unmanned air Turbine Eng and augmento gration of inlet er range and ced life cycle es and ed on improvi ts providing e aircraft, and y transition fo tional	ine rs. .s, ng
(U) N t	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Design, fabricate urbofan/turbojet engines. These tech of current and future Air Force aircraf	e, and demonst mologies will i	rate durability	U	U		<u>FY 20</u> 1.4		<u>Y 2007</u> 1.315	<u>FY 2008</u> 0.825	<u>FY 2009</u> 1.259
c t	n FY 2006: Designed and developed components to include advanced aero between the inlet and fan, and control	dynamics for f s/accessories.	fans, turbines,	mechanical s	ystems, interac	ctions					
	in FY 2007: Fabricate agile combat s nclude advanced aerodynamics for fa		-		•	•					
			•			the inlet					

	Exhibit R-2a, RDT&E Project Jus	February	2007			
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace F Power Technology	Propulsion and		MBER AND TITLE ft Propulsion s Int	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	and fan, and controls/accessories. In FY 2008: Begin testing agile combat support engine technologies to increase du components to include advanced aerodynamics for fans, turbines, mechanical syste between the inlet and fan, and controls/accessories.	-				
(U)		e fans, turbines,				
(U) (U)	MAJOR THRUST: Design, fabricate, and test advanced component technologies performance and fuel consumption of turbofan/turbojet engines for fighters, bombe supersonic and hypersonic cruise vehicles, surveillance aircraft and transports. East technology innovations can be applied to a significant part of the Air Force's engin potentially significant performance enhancements to future aircraft engines enablir responsive systems with longer range and greater payload. Design, fabricate, and to component technologies for improved performance, fuel consumption, durability a adaptive engines in full-engine environments. Note: In FY 2009, increased funding and substantial testing that will begin on large demonstrator engines. The funding increased in FY 2009 and out due to emphasis on component development in suppr technologies.	ers, sustained ch of these component e inventory and offer g faster, more est advanced nd cost for mission g is for final assembly in this effort has been	10.834	9.086	8.945	25.885
(U)	In FY 2006: Completed fabrication and testing of the multi-property rotor, fluidic modulated turbine cooling. Designed advanced lightweight engine concept (utilize compressor, and low profile combustor) capable of operating as primary propulsion Initiated advanced engine designs for a sustained supersonic engine using variable advanced fan, improved turbine using cooled metal and cooled ceramic matrix con lightweight CMC cases and ducts.	s a hollow fan, radial 1 or in a lift mode. cycle features, an				
(U)		y propulsion or in a g variable cycle				
(U)	In FY 2008: Finish testing of lightweight high bypass engine components (utilizes	a hollow fan and				
Pro		e Item No. 23 e-17 of 31			Exhibit R-2a (F	PE 0603216F)

	Exhibit R-2a, RDT&E Project Just	ification		DAT	E February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Power Technology	Propulsion and		MBER AND TITLE ft Propulsion s Int	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> radial compressor) capable of operating as primary propulsion or in a lift mode. Begi assembly of advanced engine designs for a supersonic engine using variable cycle fer fan, improved turbine using cooled metal and cooled CMCs, advanced augmentor, an CMC cases and ducts.	atures, advanced	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Finish assembly and begin testing of engine designs for a supersonic an using variable cycle features, an advanced fan, improved turbine using cooled metal advanced augmentor, and lightweight CMC cases and ducts. Initiate design of high l efficient engine. Begin preliminary design of advanced adaptive cycle (third air streat technologies, including an advanced fan, high work low turbine for long dwell time, integration, and advanced exhaust nozzle for sustained supersonic flight vehicle.	and cooled CMCs, oypass ultra fuel am) engine				
(U) (U)	MAJOR THRUST: Design, fabricate, and test advanced component technologies for engines. These technologies improve the performance, durability, and affordability missile and unmanned air vehicles (UAVs), and subsonic to hypersonic weapon appl	of engines for	5.258	3.879	6.689	4.806
(U)	In FY 2006: Designed and fabricated advanced high temperature cooled turbine blac for UAV applications. Designed advanced components for technologies for intellige engine testing to include an advanced fan/compressor, a ceramic turbine, turbine with cooling approach, and oil-less bearings.	le and combustor nt and durability				
(U)	In FY 2007: Continue fabrication of advanced high temperature cooled turbine blade UAV applications. Begin fabrication of advanced components for technologies for in durability engine testing to include an advanced fan/compressor, a ceramic turbine, the advanced cooling approach, and oil-less bearings for missile applications.	ntelligent and				
(U)	• • • • • • • • • • • • • • • • • • • •	f advanced m/compressor,				
(U)		ies, oil-less bearings igh mach fuel				
Pro		tem No. 23 18 of 31			Exhibit R-2a (F	PE 0603216F)
	4	30				

Exhibit R-2a,	RDT&E Project Justification		DAT	E February	2007			
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	Advanced Technology Development (ATD) 0603216F Aerospace Power Technology							
(U) <b>B. Accomplishments/Planned Program (\$ in Millions</b> turbine engine for improved fuel efficiency improving ra efficient subsonic unmanned turbofan engine.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Versatile Affordable Advar</li> <li>(U) In FY 2006: Conducted system studies for the multi-pure extend its applicability to engines in the 5,000 to 7,000 p</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> </ul>	rpose core and associated design activities to	1.154	0.000	0.000	0.000			
<ul> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: X-43C Development.</li> <li>(U) In FY 2006: Designed combined cycle engine propulsion demonstration under X-43C. System design options incomplexe research flight test configurations. Combined cycle engine with high-speed turbine and/or rocket engines. The turb include technology elements traceable to full-scale vision cycle engine propulsion system was assessed analytically mode transition during takeoff, transonic acceleration, statement.</li> </ul>	lude legacy X-43C, X-51 derivative, and other ne propulsion system combines scramjet engines bine, rocket and scramjet engine components on concepts. The performance of the combined by for performance, thrust margin, and propulsion	0.986	0.000	0.000	0.000			
<ul> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>								
(U) CONGRESSIONAL ADD: XTC58F Technology Versa Program (Note: Only for the XTC 58F/1 demonstrator p Versatile Affordable Advanced Turbine Engine.		6.539	7.970	0.000	0.000			
(U) In FY 2006: Updated the preliminary design and config changes necessary to accommodate both UAV and heav advanced component technologies for UAV applications	y lift applications. Created detailed design of							
<ul> <li>(U) In FY 2007 Establish a conceptual design of a highly eff the small turbofan core. Design and evaluate a high pres improved seals, and thermal barrier coating for the high</li> </ul>	ficient embedded turbine engine based around ssure compressor rig; improved bearings,							
Project 4921	R-1 Line Item No. 23 Page-19 of 31			Exhibit R-2a (F				

Exhibit R-2a, RDT&E Project Jus	ification		DA		007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TI	pace Propulsion and		February 2 UMBER AND TITLE raft Propulsion ms Int	2007
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
as incorporation of a variable exhaust nozzle.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
<ul><li>(U)</li><li>(U) CONGRESSIONAL ADD: Acceleration VAATE Advanced Supersonic Cruise Mi</li></ul>	cilo Engino	5.770	5.479	0.000	0.000
(b) CONORESSIONAL ADD. Acceleration VAATE Advanced Supersonic Cruise Mill (formerly VAATE Advanced Supersonic Cruise Missile Engine).	she Englie	5.770	5.479	0.000	0.000
<ul><li>(U) In FY 2006: Performed risk reduction rig designs for the turbine, afterburner, and n</li></ul>	ozzle components.				
Conducted testing of the rigs when fabrication was completed and developed fabrica	-				
cast blisk turbine utilizing an advanced cooling concept.					
(U) In FY 2007: Continue to define and develop Long Range Strike Mach 4+ expendab	e turbine engine				
technologies.					
<ul><li>(U) In FY 2008: Not Applicable.</li><li>(U) In FY 2009: Not Applicable.</li></ul>					
(U) III F I 2009: Not Applicable. (U)					
(U) Total Cost		31.996	27.729	16.459	31.950
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>					
<u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2</u>	009 <u>FY 2010</u>	<u>FY 2011</u> <u>FY 2011</u>	<u>2 FY 20</u>	<u>)13</u> <u>Cost to</u> ,	Total Cost
	mate <u>Estimate</u>	Estimate Estima	<u>te</u> <u>Estin</u>	nate <u>Complete</u>	<u>10tai Cost</u>
(U) Related Activities					
(U) PE 0602201F, Aerospace					
Flight Dynamics. (U) PE 0602203F, Aerospace					
Propulsion.					
(U) PE $0603003$ A, Aviation					
Advanced Technology.					
(U) This project has been					
coordinated through the					
Reliance 21 process to					
harmonize efforts and eliminate duplication.					
eminiate duplication.					
	tem No. 23 20 of 31			Exhibit R-2a (PE	
	<u>32</u>				_ 00002101 )

		DATE		
Exhibit R-2a, RDT&E			February 2007	
UDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 4921 Aircraft Propulsion Subsystems Int		
U) <b>D. Acquisition Strategy</b> Not Applicable.				
Project 4921	R-1 Line Item No. 23 Page-21 of 31		Exhibit R-2a (PE 0603216	
	433 UNCLASSIFIED			

		Exhibit R-2	2a, RDT&B	E Project 、	Justificatio	on			DATE	February	2007
	BET ACTIVITY dvanced Technology Developm	ent (ATD)			06032	1BER AND TITL 16F Aerospa • Technolog	ace Propuls	ion and 4	ROJECT NUMBE 922 Space & ropulsion		ket
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
4922	Space & Missile Rocket Propulsion	Actual 7.713	Estimate 4.821	Estimate 4.734	Estimate 5.138	Estimate 5.331	Estimate 5.422	Estimate 5.535	Estimate 5.673	Complete Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	This project develops and demonstrate and surveillance efforts) and tactical r and launch costs are emphasized. Inc of compact, lightweight, advanced pro- fundamentals), and high-energy prope performance of expendable systems' p approximately 25 percent (Phase I)/35 percent, enabling motor replacement f support the Integrated High Payoff Re-	ockets. Charac reased life and opulsion systen ellants. Techno oayload capabil 5 percent (Phase for cause. The p	eteristics such performance as, higher efficional logical advan ities by appro e II). Aging a projects in this	as environme of propulsion ciency energy ces developed ximately 25 p and Surveillan s program are	ental acceptabi systems are key conversion sy d in this progra percent (Phase ace efforts could	lity, affordabi ey goals. Tech ystems (derive am are being a I)/35 percent ld reduce lifet	lity, reliability hnology areas d from an imp ccomplished i (Phase II) and ime prediction	y, reduced we investigated proved unders in two phases reduce hardw uncertaintie	ight, and reduct include ground standing of cor and that could ware and opera s for individua	ced operation d demonstration houstion d improve the tion costs by l motors by 50	ons
(U) (U) (U) (U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop and der (PBCS) technologies for ballistic mis completed following the Missile Prop In FY 2006: Developed hardware int Propulsion Demonstration Phase I. In FY 2007: Complete the Missile Pr In FY 2008: Not Applicable. In FY 2009: Not Applicable.	nonstrate missi siles. Note: In pulsion Demons regrating case, 1	le propulsion FY 2007, eff stration. 10zzle, insulat	orts within th	is thrust will b	e	<u>FY 20</u> 2.1		<u>Y 2007</u> 3.768	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
	MAJOR THRUST: Develop and der technologies for strategic systems. E - Phase II. Note: After FY 2006, the separate activity in this project. In FY testing in a significant full scale Miss In FY 2006: Developed the necessary development of missile components.	fforts support the aging and survey 2008 and FY ile Propulsion of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior of the superior	he Technolog eillance effor 2009, funding demonstration	y for Sustainn ts in this activ g increase sup	nent of Strateg vity will becon oports build up	tic Systems ne a and	3.7	37	0.587	3.011	3.970
Proj	ect 4922				Line Item No. 2 Page-22 of 31 434	3				Exhibit R-2a (F	PE 0603216F)

	Exhibit R-2a, RDT&E Project	Justification		DATE	E February	2007	
	GET ACTIVITY Advanced Technology Development (ATD)		CT NUMBER AND TITLE Space & Missile Rocket Ilsion				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Complete modeling and simulation tools (Phase II) development developing missile components. Begin development of subcomponents to test previously developed modeling and simulation tools and update the models wi use in an upcoming Missile Propulsion demonstration.	the accuracy of the					
(U)	In FY 2008: Continue development of subcomponents to test the accuracy of modeling and simulation tools and update the models with the resulting data for Missile Propulsion demonstration.						
(U)	In FY 2009: Complete sub-scale component developments providing sub-scal and simulation tools. Initiate full-scale demonstration of advanced missile pro advanced solid propellants, and advanced modeling and simulation tools.						
(U)							
(U)	MAJOR THRUST: Develop and demonstrate aging and surveillance technolo to reduce lifetime prediction uncertainties for individual motors by 50%, enable cause. Efforts support the Technology for Sustainment of Strategic Systems Pt 2006, the aging and surveillance efforts were part of another effort in this Projection 2006.	ing motor replacement for ase II. Note: Prior to FY	0.381	0.466	1.723	1.168	
	In FY 2006: Developed the necessary aging and surveillance tools for predictive rocket motors and methods. Applied these tools on a motor-by-motor basis violation In FY 2007: Initiate scale-up activities for an advanced service life prediction	ng the health of solid ce a fleet wide basis.					
	existing and advanced sensors, models, and tools to be able to predict the servi motor on a motor-by-motor basis.	ce life of a solid rocket					
(U)	In FY 2008: Continue scale-up activities for an advanced service life prediction existing and advanced sensors, models, and tools to be able to predict the service motor on a motor-by-motor basis.						
(U)	In FY 2009: Begin full-scale demonstration of advanced aging and surveilland motors to validate and verify modeling and simulation tools and component terms and surveilland terms are supported as the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement of the statement						
(U)							
(U)	CONGRESSIONAL ADD: Solid Boost Power Technology.		1.443	0.000	0.000	0.000	
	In FY 2006: Conducted component testing and modeling, simulation, and ana solid rocket motor technologies supporting future ballistic missile upgrades.	lysis tool validation for					
	In FY 2007: Not Applicable. In FY 2008: Not Applicable.						
	R-	1 Line Item No. 23					
	ject 4922	Page-23 of 31				PE 0603216F)	

	Exhibi	: R-2a, RD1		t Justifica				DATE			
BUDGET ACTIVITY 03 Advanced Technology Deve				PE N 060	UMBER AND TI 3216F Aeros ver Technolo	pace Propuls	sion and		February 2007 NUMBER AND TITLE Dace & Missile Rocket Sion		
<ul> <li>(U) <u>B. Accomplishments/Planned</u></li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> </ul>	d Program (\$ in	<u>Millions)</u>				<u>FY 2</u>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
						7.	713	4.821	4.734	5.138	
<ul> <li>(U) <u>C. Other Program Funding S</u></li> <li>(U) Related Activities:</li> <li>(U) DE 0(02102E Metaricle</li> </ul>	<u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> FY 2007 Estimate	<u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estima</u>		<u>3 Cost to</u> te Complet	<u>-</u> <u>Total Cost</u>	
<ul> <li>(U) PE 0602102F, Materials.</li> <li>(U) PE 0602203F, Aerospace Propulsion.</li> <li>(U) PE 0602601F, Spacecraft</li> </ul>											
Technology. (U) PE 0603401F, Advanced Spacecraft Technology.											
<ul> <li>(U) PE 0603500F, Multi-Disciplinary Advanced Development Space Technology.</li> </ul>											
<ul> <li>(U) PE 0603853F, Evolved</li> <li>Expendable Launch Vehicle</li> <li>Program.</li> </ul>											
<ul> <li>PE 0603114N, Power</li> <li>Projection Advanced</li> <li>Technology.</li> </ul>											
<ul> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>											
(U) <b><u>D. Acquisition Strategy</u></b> Not Applicable.											
Project 4922			I	R-1 Line Item No Page-24 of 3					Exhibit R-2a (	PE 0603216F)	
			U	436 JNCLASSIF	IED						

	Of 003216F Aerospace Propulsion and Power Technology5098 Advanced Aerospace PropulsionCost (\$ in Millions)FY 2006FY 2007FY 2008FY 2009FY 2010FY 2011FY 2012FY 2013Cost toTotalAdvanced Aerospace Propulsion22.18734.03621.88623.23324.60624.51323.56724.125ContinuingTBDQuantity of RDT&E Articles00000000000In FY 2007, funding increases to support ground demonstrations and fabricate test vehicles for out-year flight demonstrations											
	ET ACTIVITY Ivanced Technology Developme	ent (ATD)			06032	16F Aerospa	ace Propuls	ion and	5098 A	dvance		e
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 201	2 F	Y 2013	Cost to	Total
	· · · ·										Complete	
5098								23.5			Continuing	TBD
		÷	-		ÿ	ů	ş		0	0		
	A. Mission Description and Budget This project develops and demonstrate other engine cycles (including turbine hydrocarbon-fueled, scramjet engine. operating over the range of Mach 0 to active combustion control to assure con naximized volume-to-surface area to	Item Justifica es via ground a and rocket-ba Multi-cycle e 8+. Efforts ir ontinuous positi minimize the	tion and flight tests sed) to provid ngines will pro- clude scramje tive thrust (even thermal load in	the scramjet e the Air Forc ovide the prop t flow-path op en during moc nposed by the	propulsion cyc e with transfo pulsion system ptimization to le transition), 1 e high-speed en	cle to a techno rmational mili s for possible enable operati- robust flame-h ngine. Therma	logy readines tary capabiliti application to on over the w olding to mai al managemen	s level app les. The p support a idest poss ntain stabi nt plays a v	rimary fo ircraft ar ible rang lity thro vital role	ocus is or id weapor e of Mac ugh flow	the n platforms h numbers, distortions, ar	ıd
(U) (U)		nonstrate techn n 4 to 8. gn of the scram esigns for stru nultiple risk re- nties prior to C wind tunnel to totors. Conduc- ts requiremen ystem subcom ound test matri- hicle designs a itiate fabricati- hicle flight har air vehicle flight	nologies for a langet engine der ctures, avionic duction tests a critical Design ests and simul- cted aero-thern ts. Conduct ac ponents (hot g ix to better ali and conduct ve on of flight en- dware and be- ght hardware a	monstrator air es, instrument nd analyses to Review. Con taneously con nodynamic ar diditional prop gas valves, dig gn with expec- chicle critical gines. Establ gin flight test and finalize fli	vehicle. Com ation, booster, o reduce both nducted extens duct computat nalyses to ensu- ulsion related gital engine con- cted flight prof design review ish flight test p preparations a	npleted and other ive ional fluid ure vehicle risk ntroller, ïles. . Fabricate profiles and t			<u>FY 200</u> 34.03		<u>FY 2008</u> 21.886	<u>FY 2009</u> 23.233
	In FY 2009: Conduct integrated air v ct 5098	ehicle/propuls	ion flight tests	R-1	post test data i Line Item No. 2 Page-25 of 31 437						Exhibit R-2a (P	E 0603216F)

Exhibit R	-2a, RDT	&E Projec	t Justifi	cation			DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)			0	E NUMBER AND TI 603216F Aeros ower Technolo	pace Propulsi	on and		IBER AND TITLE	
(U) <b><u>B. Accomplishments/Planned Program (\$ in Mil</u> and reporting.</b>	llions)				<u>FY 20</u>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Total Cost					22.1	87	34.036	21.886	23.233
	ons) <sup>2</sup> Y 2007 Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> Estimat		FY 2011 Estimate	FY 2012 Estimat		<u>S Cost to</u> te <u>Complet</u>	<u>-</u> <u>Total Cost</u>
Project 5098			R-1 Line Item Page-26 c 438	f 31				Exhibit R-2a (	PE 0603216F

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	EXhibit R-2a, RD1&E Project Justification       February 2007         ET ACTIVITY byanced Technology Development (ATD)       PROJECT NUMBER AND TITLE B0321GF Aerospace Propulsion and Dower Technology       PROJECT NUMBER AND TITLE B01B Advanced Turbine Engine Gas Generator										
	Cost (\$ in Millions)										Total
681B	-	23.427	27.922	33.507	54.536		48.168	29.0		4 Continuin	g TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0 (	)	
efficie (U) <u>4</u> T V E E E C C L L L A A A F F	A. Mission Description and Budget This project develops and demonstrate veight, fuel consumption, and cost of performance, cost, durability, reparab- block of the engine and nominally cor- engine demonstration validates engine can be applied to derivative and/or ne- and combat vehicles, ships, and respo- ow spool components (such as inlet s and thermal management systems) on validated on demonstrator engines in 1 of this project supports the demonstrator provides optimized performance, fuel	bine engines, and small heavy fueled engines. <b>ription and Budget Item Justification</b> lops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while umption, and cost of ownership. The objective is to provide the continued evolution of technologies into an advanced gas generator in wh t, durability, reparability, and maintainability can be assessed in a realistic engine environment. The gas generator, or core, is the basic bu ne and nominally consists of a compressor, a combustor, a high-pressure turbine, mechanical systems, and core subsystems. Experimental ation validates engineering design tools and enhances rapid, low-risk transition of key engine technologies into engineering development, v derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, cles, ships, and responsive space launch. Component technologies are demonstrated in a core (sub-engine). This project also assesses the nents (such as inlet systems, fans, low pressure turbines, and exhaust systems) and system level technologies (such as integrated power ge agement systems) on core engine performance and durability in "core-centric engine" demonstration. The core performances of this project onstrator engines in Project 4921 of this PE. Efforts are part of the Versatile Affordable Advanced Turbine Engines (VAATE) program. A poports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture the performance and the versatile Affordable Advanced Turbine Engines (versatile the performance) systems and encloue performance and the versatile affordable Advanced Turbine Engines (versatile the poports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture the performance and performance and performance and performance and performance and performance				e while reducit or in which th pasic building imental core oment, where ircraft, missile sses the impac ower generator s project are gram. A porti- cture that	ng e chey es, t of rs on				
(U) I i s t	MAJOR THRUST: Design, fabricate nnovative engine cycles and advance and reduced fuel consumption for tur- sustained supersonic and combined cy- technology innovations can be applied potentially significant performance en-	e, and demonst ed materials to bofan/turbojet ycle hypersoni d to a significa hancements to able, more resp lity.	rate performan provide greate engines for fig c cruise vehic ant part of the o future aircrate ponsive system	er durability, i ghters, attack les, and large Air Force's en ft engines, thu ns with longer	mproved perfo aircraft, bombo transports. Ea gine inventory s enabling nev	ormance, ers, ch of these and offer v					
U) I t	acchnologies, including advanced turb novel coatings to reduce combustor a	oine blade mat	erials incorpor	rating next gen ic turbine com	neration coolin	g schemes, systems for					

Exhibit R-2a, RDT&E Project Jus	tification		DATE February	2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion a Power Technology		CT NUMBER AND TITLE Advanced Turbine	
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> active control, thermal management, and power extraction. Created preliminary des reduction planning for a tip turbine concept, including a novel compression system, combustor, and advanced rotating seals. Explored design of unique compression system</li> <li>(U) In FY 2007: Complete detailed design and begin fabrication of advanced core engine including advanced turbine blade materials incorporating next generation cooling sec coatings to reduce combustor and turbine heat loads, ceramic turbine components, a control, thermal management, and power extraction. Complete preliminary design a planning for a tip turbine concept, including a novel compression system, innovative and advanced rotating seals. Continue design and begin fabrication of unique comp</li> </ul>	innovative annular stem components. he technologies, hemes, novel nd systems for active and risk reduction e annular combustor,	<u>FY 20</u>	<u>07 FY 2008</u>	<u>FY 2009</u>
<ul> <li>components.</li> <li>(U) In FY 2008: Complete fabrication and initiate instrumentation and assembly of adv. components, including advanced turbine blade materials incorporating next generati novel coatings to reduce combustor and turbine heat loads, ceramic turbine compone active control, thermal management, and power extraction. Complete detailed desig fabrication for a tip turbine concept, including a novel compression system, innovati combustor, and advanced rotating seals. Complete design and fabrication of unique components. Initiate preliminary design of high temperature capable, durable comp and turbine for sustained supersonic long range strike core engine.</li> </ul>	on cooling schemes, ents, and systems for n and initiate ve annular compression system ressor, combustor,			
(U) In FY 2009: Complete assembly and demonstration of advanced core engine comport advanced turbine blade materials incorporating next generation cooling schemes, not reduce combustor and turbine heat loads, ceramic turbine components, and systems thermal management, and power extraction. Complete fabrication and initiate perfor demonstration of a tip turbine concept, including a novel compression system, innov combustor, and advanced rotating seals. Complete fabrication, assembly and experi demonstration of unique compression system components. Complete preliminary de temperature capable, durable compressor, combustor, and turbine for sustained super strike core engine.	vel coatings to for active control, rmance rative annular mental esign of high			
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Design, fabricate, and demonstrate high overall pressure ration increased durability and affordability with lower fuel consumption for turbofan/turb long endurance high altitude unmanned air vehicles for persistent intelligence survei</li> </ul>	oshaft engines for	3.5	47 12.085	12.505
	Item No. 23 28 of 31		Exhibit R-2a (	PE 0603216F)
	40			· · · · · · · · · · · · · · · · · · ·

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Power Technology	Propulsion and		BER AND TITLE ced Turbine E	Engine Gas
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> reconnaissance, intertheater/intratheater transports, subsonic Unmanned Air Systems powered munitions. Note: The funding in this effort has been increased in FY 2008 emphasis on component development in support of highly efficient embedded turbing heavy fueled engines.	and out due to	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2006: Completed preliminary design of core for highly efficient core engine c advanced core technologies including high efficiency, high pressure ratio, high tempe compressor, high efficiency, high heat release combustor, and high work, high coolin turbine with an integrated thermal management system and advanced mechanical sys design and initiated experimental performance demonstration of multi-service heavy technologies for future rotorcraft.	erature capability g effectiveness tems. Completed				
(U)	In FY 2007: Complete detailed design and initiate fabrication of core components for core engine concept with advanced core technologies including high efficiency, high temperature capability compressor, high efficiency, high heat release combustor, and cooling effectiveness turbine with an integrated thermal management system and adv systems. Complete experimental demonstration of the multi-Service heavy fuel engin future rotorcraft.	pressure ratio, high high work, high anced mechanical				
(U)	In FY 2008: Complete fabrication and initiate assembly of highly efficient core engi concept with advanced core technologies including high efficiency, high pressure rat capability compressor, high efficiency, high heat release combustor, and high work, h effectiveness turbine with an integrated thermal management system and advanced m Create preliminary design of UAS small versatile affordable advanced core engine te including an efficient high pressure compressor, a high heat release combustor, high turbine, and systems for thermal management and advanced power extraction.	io, high temperature high cooling hechanical systems. chnologies				
(U)	In FY 2009: Complete assembly and demonstrate a highly efficient core engine conc core technologies including high efficiency, high pressure ratio, high temperature cap high efficiency, high heat release combustor, and high work, high cooling effectivene integrated thermal management system and advanced mechanical systems. Initiate d pressure ratio core components. Conduct preliminary design of core for highly effici concept with advanced core technologies including high efficiency, high pressure rat capability compressor, high efficiency, high heat release combustor, and high work, leffectiveness turbine with an integrated thermal management system and advanced me	bability compressor, ess turbine with an esign of higher ent core engine io, high temperature high cooling				
Pro	ject 681B Page-2	tem No. 23 29 of 31			Exhibit R-2a (F	PE 0603216F)
	4	41				

		Exhibit	: R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007
	ET ACTIVITY Ivanced Technology Deve	lopment (ATD	)		0603	UMBER AND TI 3216F Aeros ver Technolo	pace Propuls	ion and		IBER AND TITLE	
C C H a	<b>B. Accomplishments/Planned</b> Complete design, initiate hardw demonstrations of UAS small w neat release combustor, durable advanced power extraction.	vare fabrication, versatile affordation	and continue sole advanced c	ore engine tech	nologies inclu	ding a high	<u>FY 20</u>	<u>)06</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) I (U) I (U) I (U) I (U) I	CONGRESSIONAL ADD: Ve 581B). In FY 2006: Not Applicable. In FY 2007: Identify and evalu- power off the engine. Assess th cooling concept, and an advance In FY 2008: Not Applicable.	ate engine contr e viability of a 1	rol issues and ender the combustor	effects of rapid	ly drawing larg	ge amounts of	0.0	000	2.192	0.000	0.000
	In FY 2009: Not Applicable. Fotal Cost						23.4	427	27.922	33.507	54.536
(U) R (U) P (U) P (U) P (U) T (U) T co R h	C. Other Program Funding Se Related Activities: PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0603003A, Aviation Advanced Technology. Chis project has been oordinated through the Reliance 21 process to armonize efforts and liminate duplication.	<u>ummary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions</u> ) <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estima</u>			TOTAL COSE
Proje	ct 681B			I	R-1 Line Item No Page-30 of 31					Exhibit R-2a (	PE 0603216F)

Exhibit R-2a, RDT&E Project Justification February 2007											
DGET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJEC 681B / Genera	T NUMBER AND TITLE								
) <u>D. Acquisition Strategy</u>											
Not Applicable.											
Project 681B	R-1 Line Item No. 23 Page-31 of 31		Exhibit R-2a (PE 0603216								

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#### PE NUMBER: 0603231F PE TITLE: Crew Systems and Personnel Protection Technology

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	- ebruary 2	2007
	T ACTIVITY vanced Technology Developme	ent (ATD)			-	BER AND TITL B <b>1F Crew Sy</b>	E vstems and I	Personnel P	rotection Te	chnology	
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	33.570	43.890	28.558	29.376	37.443	34.885	34.881	37.992	Continuing	TBD
2830	Decision Effectiveness Technology	22.425	30.684	19.513	20.189	27.420	25.381	24.920	27.971	Continuing	TBD
4924	Warfighter Readiness Technology	7.688	9.274	6.249	6.682	6.602	6.043	6.429	6.412	Continuing	TBD
5020	Bioeffects & Protection Technology	3.457	3.932	2.796	2.505	3.421	3.461	3.532	3.609	Continuing	TBD

Note: Funds for the FY 2007 Congressionally-directed Deployment Environmental and Biological Surveillance System (DEBS) in the amount of \$1.0 million and Virtual Medical Trainer in the amount of \$2.2 million are in the process of being moved to the Defense Health Program from PE 0603231F, Crew Systems and Personnel Protection Technology, for execution.

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

This program develops and demonstrates technologies to enhance human performance and effectiveness and to enable the aerospace force. State-of-the-art advances are made to train personnel, protect and sustain warfighters, and improve human interfaces with weapon systems. The Decision Effectiveness Technology project develops and demonstrates warfighter capability enhancing technologies that promote effective decision-making, control, and mission execution in the emerging network-enabled operational environments. The Warfighter Readiness Technology project develops and demonstrates advanced training, simulation, and mission rehearsal technologies. The Bioeffects and Protection Technology project develops and demonstrates advanced training, simulation, and mission rehearsal technologies. The Bioeffects and Protection Technology project develops and demonstrates advanced technologies to provide laser eye protection, assure the safety of personnel involved with test, deployment, and operation of high-energy laser weapons, enhance capabilities for sustained operations in extreme environments, and deliver novel, tailored bio-taggant and identification/neutralization capabilities to meet specific AF special operations needs. Note: In FY 2007, Congress added \$2.2 million for Virtual Medical Trainer, \$1.0 million for Deployment Environmental and Biological Surveillance System (DEBS), \$1.3 million for Authentic Tactical Flight Simulator for JSF, \$1.0 million for Full spectrum Laser Eye Protection, \$1.0 million for Low Cost Improved Performance Helmet Display, \$1.0 million for Air Force Advanced Micro-Compression Sock Program, and \$1.3 million for Phasor-Bird Helmet Tracker. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies to protect and enhance the performance of Air Force personnel in operational environments.

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Exhibit R-2, RDT&E Bud	get Item Justification		DATE Februar	v 2007		
UDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems a	and Personnel Pro	•			
U) <b><u>B. Program Change Summary (\$ in Millions)</u></b>						
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
U) Previous President's Budget	34.968	32.156	32.685	35.835		
U) Current PBR/President's Budget	33.570	43.890	28.558	29.376		
J) Total Adjustments	-1.398					
J) Congressional Program Reductions						
Congressional Rescissions	-0.040	-0.166				
Congressional Increases		10.600				
Reprogrammings	-0.620	1.300				
SBIR/STTR Transfer	-0.738					
<ul> <li><u>Significant Program Changes:</u> Not Applicable.</li> </ul>						
C. Performance Metrics						
Under Development.						
-						
	R-1 Line Item No. 24 Page-2 of 23		Evhihit D '	2 (PE 0603231F		
	446		Exhibit R-2	2 (PE 0603231F		

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on					2007			
EXhibit R-2a, RDT&E Project JUStification       February 2007         SUDGET ACTIVITY       PROJECT NUMBER AND TITLE       PROJECT NUMBER AND TITLE         O3 Advanced Technology Development (ATD)       PE NUMBER AND TITLE       PROJECT NUMBER AND TITLE         O3 Advanced Technology Development (ATD)       PE NUMBER AND TITLE       PROJECT NUMBER AND TITLE         O3 Advanced Technology Development (ATD)       PE NUMBER AND TITLE       PROJECT NUMBER AND TITLE         O3 Advanced Technology Development (ATD)       PE NUMBER State       PE Summe Systems and Personnel Protection Technology       PROJECT NUMBER AND TITLE         03 Advanced Technology Development (ATD)       FY 2007       FY 2008       FY 2009       FY 2010       FY 2011       FY 2012       FY 2013       Cost to       Total         2830       Decision Effectiveness       22.425       30.684       19.513       20.189       27.420       25.381       24.920       27.971       Continuing       TB         Quantity of RDT&E Articles       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0														
Exhibit R-2a, RD1& Project Justification         February 2007           BUDGET ACTIVITY         OB Advanced Technology Development (ATD)         February 2007           OB Cost (\$ in Millions)         FY 2006         FY 2007         FY 2009         FY 2010         FY 2011         FY 2013         Cost to           Cost (\$ in Millions)         FY 2007         FY 2008         FY 2010         FY 2011         FY 2013         Cost to           Cost (\$ in Millions)         FY 2006         FY 2008         FY 2010         FY 2011         FY 2012         FY 2013         Cost to         Total           28.30         Decision Effectiveness         Cost to         Total           28.30         Decision Effectiveness         Cost to         Total           28.30         Decision Effectiveness         Cost to         Total           2.2.425         30.684         19.513         20.189         27.420         27									Total					
2830					20.189						TBD			
		0	0	0	0	0	0	0	0					
<ul> <li>Medical Trainer</li> <li>Technology, for</li> <li>(U) <u>A. Mission</u></li> <li>This project</li> <li>decision-m</li> <li>ability of b</li> <li>time-critica</li> <li>project also</li> <li>improve hu</li> </ul>	in the amount of \$2.2 milli execution. <b>Description and Budget</b> t develops and demonstrate aking, control, and mission attlefield airmen to rapidly l strikes, and warfighter in o develops technologies tha man effectiveness during a	Item Justificates swarfighter content assimilate criticates terface technolic tenhance logicates terospace and content terospace and	tion apability enha he emerging r ical informatio logies that sim stics functions cyber operatio	g moved to the ancing technol network-enable on and make to aplify and spece s, improve the ons, support de	he Defense He logies and info led operational timely and cor ed critical ope fidelity and a evelopment of	alth Program f ormation opera l environment rect decisions, rations in air o ccuracy of larg novel, tailored	from PE 0603 ations technolo . Included are , display technoperation cento ge-scale milita d bio-taggant a	231F, Crew S ogies that pror advanced tec ologies and d ers and battle : ry simulation and identificat	ystems and Pe note effective chnologies that ecision aids th management p s, protect depl tion/neutraliza	improve the at enhance olatforms. The oyed personne tion capabiliti	etion eti,			
(U) MAJOR T Operations IO/ISR wa warriors, I to reduce e	HRUST: Develop and den (IO) and Intelligence, Sur- rrior with tailored decision D/ISR simulators and traini- ver-increasing data load an	nonstrate huma veillance and H support syster ing systems, en ad improve mis	an-centered to Reconnaissanc ns, guidelines nhanced decisi ssion accompl	e (ISR) comm for effective ion-making to ishment.	nunities. Prov selection of IC ools, and auton	ide the D/ISR nated tools					<u>FY 2009</u> 2.580			
attack info Began rese	rmation. Developed IO cap	pabilities for e	nhancement b	y exemplar te	chnologies and	d methods.								
(U) In FY 200 defend, and technology planning as operators.	attack information. Cont. Develop and demonstrate	inue maturatio e tools and tec lop ISR optima l training meth	n and develop hniques to imp al displays and nodologies and	ment of IO ca prove operato l enhanced ex l tools for ISR	apabilities enh r performance ploitation for R operators.	ancement for ISR ISR								
Project 2830	. Develop and demonstration				Line Item No. 2 Page-3 of 23 447					Exhibit R-2a (P	E 0603231F)			

roject Justification		DATE	February	2007
		2830 Decisi	on Effectiven	
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
nd evaluate new regimens to s technologies and facilitate lopment.				
kinetic capabilities with kinetic				
	2.433	3.787	1.950	1.914
ns. Integrated these visualization				
net-protocol communication, to				
ts that foster command level				
plays. Technologies address pution timelines, reduced targeting tional awareness of friend and foe interfaces between ground	2.619	4.083	3.675	3.981
	PE NUMBER AND TITLE 0603231F Crew Syst	PE NUMBER AND TITLE         0603231F Crew Systems and Personnel Protection Technology         EY 2006         ogies to exploit data from new ISR and evaluate new regimens to is technologies and facilitate elopment. generation IO/ISR operator -kinetic capabilities with kinetic ols for IO/ISR operators.         echnologies to improve combat upport for Combined Air and Space         cused on the areas of strategy ons. Integrated these visualization assessment.         erational environment or exercise.         rnet-protocol communication, to vith other groups in the CAOC. and dynamic operational effects ints that foster command level on-making.         ools to create a seamless flow of e a final visually-oriented, unified         acce between ground controllers and splays. Technologies address cution timelines, reduced targeting bitional awareness of friend and foe interfaces between ground ne wargaming simulations and field (display portrayal concepts that	Project Justification       PROJECT NUM         PE NUMBER AND TITLE       PROJECT NUM         Q603231F Crew Systems and Personnel Protection Technology       PROJECT NUM         2830 Decisi Technology       EY 2006       EY 2007         ogies to exploit data from new ISR and evaluate new regimens to is technologies and facilitate elopment.       EY 2006       EY 2007         ogies to improve combat       2.433       3.787         upport for Combined Air and Space       2.433       3.787         cused on the areas of strategy ons. Integrated these visualization issessment.       2.433       3.787         erational environment or exercise.       rnet-protocol communication, to vith other groups in the CAOC.       and dynamic operational effects ints that foster command level in-making.       2.619       4.083         ools to create a seamless flow of e a final visually-oriented, unified       2.619       4.083         ace between ground controllers and splays. Technologies address cution timelines, reduced targeting ititional awareness of friend and foe interfaces between ground ne wargaming simulations and field display portrayal concepts that       2.619       4.083	Project Justification       February         PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology       PROJECT NUMBER AND TITLE 2830 Decision Effectiven Technology         Big is to exploit data from new ISR and evaluate new regimens to is technologies and facilitate elopment. generation IO/ISR operator kinetic capabilities with kinetic ols for IO/ISR operators.       FY 2006       FY 2007       FY 2008         echnologies to improve combat upport for Combined Air and Space       2.433       3.787       1.950         cused on the areas of strategy ons. Integrated these visualization isessment.       3.787       1.950         cused on the areas of strategy ons. Integrated these visualization isessment.       seesment.       9.4083       3.675         cused on the areas of strategy ons. Integrated these visualization isessment.       9.619       4.083       3.675         obs to create a seamless flow of e a final visually-oriented, unified       2.619       4.083       3.675         splays. Technologies address cution timelines, reduced targeting ititonal awareness of friend and foe interfaces between ground ne wargaming simulations and field display portrayal concepts that       3.619       4.083       3.675

	Exhibit R-2a, RDT&E Project Justification February 2007							
	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Techn			UMBER AND TITLE sion Effectiveness gy			
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>	FY2	2006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	optimize net-centric information flow to system operators. In FY 2006: Developed intelligent unmanned air vehicle (UAV) search path location. Began to develop UAV display tools that speed the delivery of U. cultural and targeting information to special operations forces. Continued t speech recognition and language translation customized for ground controll Attack Control (TAC) complex microphones	AV imagery integrated with o develop user independent						
U)	Attack Control (TAC) earplug microphones. In FY 2007: Complete development and demonstration of advanced interfa ground controllers and multiple machine components through unified visua Demonstrate UAV interfaces featuring intelligent agent search patterns in the operational environment. Demonstrate operator headgear incorporating base and wearable displays. Demonstrate user independent speech recognition a	l and auditory displays. he ground controller sic operator status reporting and language translation						
(U)	customized for ground controller equipment and TAC earplug microphones In FY 2008: Commence a spiral development to extend the capabilities of technologies that link ground controllers with multiple machine component auditory displays. Demonstrate in an operational setting improved human i of target data, in order to improve speed and accuracy while offering a com Joint services interoperability. Provide human factors design updates to bat components, providing faster setup and deployment of micro-UAV as well	the advanced interface s through unified visual and interaction with transmission mon situation display for ttlefield air operations kit						
U)	management for wearable components. Demonstrate user-independent spectranslation customized for ground controller equipment and TAC earplug mand software implementation of a supervisory control station technology bad development for a next-generation supervisory control station, and plan to a terms of operator mission performance and overall usability relative to the terms of the development of develop and demonstrate human systems integrate controllers and other battlefield airmen. Demonstrate technologies for three	nicrophones. Begin hardware asseline. Begin concept assess projected benefits in technology baseline station. ion concepts for ground						
	navigation in visually obscured environments while improving team situation geo-location of voice communications. Incorporate a geo-located survival computer, and demonstrate its value in an operationally relevant environme an advanced battlefield air traffic control capability in the combat controller Incorporate intelligent agent technology to improve battlefield airmen situation dynamic wartime scenario. Complete hardware and software implementation	onal awareness by guide into a wearable ent. Develop and incorporate r's software suite. tional awareness in a						
	ect 2830	R-1 Line Item No. 24						

Exhibit R-2a, F	Exhibit R-2a, RDT&E Project Justification February 2007								
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)		PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology			ess				
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> station technology baseline and a next-generation supervise demonstration program using real-time system simulation phases. Establish the scope of simulation and test activities key performance measures and commence the assessment	and field testing in spiral demonstration es, select experimental variables, determine	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>				
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop and demonstrate decision-ai Commander (JFC)/Joint Forces Air Component Command situation, predict the most likely adversary behaviors, and action.</li> </ul>	ding technologies that assist the Joint Forces der (JFACC) to rapidly assess the battlefield	0.412	1.006	1.855	2.263				
<ul> <li>(U) In FY 2006: Developed a scenario-based cognitive work persistent attack missions as a command and control know Environment (CPE). Developed an initial CPE decision a</li> </ul>	vledge base for the Commander's Predictive								
(U) In FY 2007: Begin first spiral development cycle of a dec operations by providing a common global picture, fully in supporting intelligence. Enable real-time reachback to op sources.	tegrating military planning, operations, and								
(U) In FY 2008: Complete the first spiral development of CPI strike and global persistent attack missions. Plan a techno benefits and utility of tools. Expand the scope of the scen non-traditional warfare such as humanitarian relief and glo analysis with this expanded scope.	blogy demonstration program to evaluate ario-based cognitive work to include								
(U) In FY 2009: Integrate tools developed in first spiral into i Evaluate the CPE decision aids and simulation tools in the Refine tools and begin the second spiral development cycl demonstration with humanitarian relief and global war on evaluate the expanded benefits and utility of the decision a demonstration program.	e technology demonstration environment. le informed by the results of the technology terrorism emphases. Identify exercise to								
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop and demonstrate advanced v integrated day/night capability to reduce pilot workload at 2007, this effort is discontinued to align work with higher</li> </ul>	nd enhance mission performance. Note: In FY	2.024	0.251	0.000	0.000				
Project 2830	R-1 Line Item No. 24 Page-6 of 23			Exhibit R-2a (	PE 0603231F)				

	Exhibit R-2a, RDT&E Project Justification DATE February 2007								
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Sys Personnel Protectio				R AND TITLE Effectiveness			
	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
	In FY 2006: Developed lightweight, ruggedized displays that operate in dem environments. Performed a laboratory evaluation to determine the optimal co information to special operations personnel. Investigated the utility of incorp sensors into a single helmet-mounted display.	onfiguration to present porating day and night							
(U)	In FY 2007: Complete technology contribution to incorporate night agile las displays.	er protection in airborne							
(U)	In FY 2008: Not Applicable.								
(U) (U)	In FY 2009: Not Applicable.								
	MAJOR THRUST: Develop and demonstrate novel, tailored bio-taggant and identification/neutralization capabilities to meet specific AF needs to enhance enable air operations commanders to maintain operations tempo.		0.391	1.180	1.503	1.522			
(U)	In FY 2006: Defined parameters of biological warfare agent identification. identification technologies and appropriate testing methods and conditions to evaluations.								
(U)	In FY 2007: Evaluate the capabilities of emerging aptamer technologies to e capabilities. Begin development of these DNA-based identification and neut will lead to affordable and reliable techniques for special forces to locate, ide enemy activities.	ralization technologies that							
(U)	In FY 2008: Select the best emerging technologies for bio-taggant and threat and begin to develop those technologies into fieldable counterproliferation ca technology will also be used to enhance the effectiveness of the cold plasma technologies. Develop the capability to attach quantum dots and mixed-meta to serve as taggants for biological agents.	apabilities. Aptamer based and directed energy							
(U)	In FY 2009: Further develop the selected technologies and refine application incorporation of quantum dot and mixed-metal nanoparticle technologies. D insertion/distribution of bio-taggants in target areas.								
(U)									
(U)	MAJOR THRUST: Develop and demonstrate intelligent software agents, rea organizational behavior models, and advanced job performance aiding techno and models add realism and fidelity to large-scale synthetic environments and	ologies. Computer agents	3.879	3.671	4.519	1.180			
Proj	ject 2830	R-1 Line Item No. 24 Page-7 of 23			Exhibit R-2a (	PE 0603231F)			

Exhibit R-2a, RDT&	February	2007				
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)		PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology			IBER AND TITLE on Effectiveness	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> intelligence analysts a way to model collected data. Job aiding to control operators with automated access to a manageable amount avoid operator overload and to support fast and accurate decision	t of multi-source critical information to	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2006: Evaluated methods to improve validating human per human performance model that can represent behavioral variatio transition a set of work-centered collaborative planning and decis Mobility Command. Began to develop composable human-comp assembled via computer network into a rapidly reconfigurable composable configurable composable for the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set of the set	erformance models. Began to develop a ns due to cultural differences. Began to sion-making software tools to Air puter interface elements that can be					
(U) In FY 2007: Begin a series of critical experiments toward model systems. Complete the transition of work-centered collaborative to the Air Mobility Command. Continue to develop composable computer interface elements that can be assembled via computer C2 system. Conduct initial laboratory experiments on composable	planning and decision-making software command and control (C2) human network into a rapidly reconfigurable					
<ul> <li>(U) In FY 2008: Continue to develop and experiments on composable</li> <li>(U) In FY 2008: Continue to develop and experiment with system-orthe complexity and degree of dynamic change. Expand develops planning, analysis, and decision-making software tools into the u dynamic mission re-synchronization. Investigate the value of im as services or as service layers of an enterprise architecture.</li> </ul>	f-systems societal modeling, increasing nent of work-centered collaborative nstructured C2 work environment of					
(U) In FY 2009: Continue to develop human behavior modeling of dynamic situations. Continue to experiment with system-of-syst increasingly complex scenarios. Demonstrate how information f society. Develop design reference scenarios to be used as standa approaches. Continue to evaluate promising models and modeling approaches.	ems societal modeling, using lows through and is modified by a rds for evaluating different modeling					
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop and demonstrate logistics technology operations and improved system supportability. These technology effectiveness of AF deployments and mobility operations in suppart Air Expeditionary Force concepts.</li> </ul>	ies will improve the efficiency and	4.051	2.039	1.229	2.702	
(U) In FY 2006: Developed and applied technology to automatically required to effectively manage logistics resources in support of c and develop very fast, easy-to-use dynamic planning/replanning	ombat operations. Continued to design					

	Exhibit R-2a, RDT&E Project Justification February 2007								
BUDGET A <b>03 Adva</b> i	ACTIVITY nced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Syst Personnel Protection			OJECT NUMBER AND TITLE 30 Decision Effectiveness				
(U) <u>B. A</u>	Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
	attinued work to define coalition C2 information requirements to support cross-cul	tural planning and							
	rdination. Y 2007: Complete development and application of technology to automatically	collect and undate							
	cal information required to effectively manage logistics resources in support of c								
	nplete design and development of very fast, easy-to-use dynamic planning/replan	-							
	ptive logistics. Continue work to define coalition C2 information requirements to								
cros	ss-cultural planning and coordination. Begin work on defining requirements for e	mergency response							
-	stics needs.								
	Y 2008: Evaluate methods for organizational impact analysis of new information								
	work-based tools to support collaborative logistics. Collect human-centric perform cal experiments and joint exercises to benchmark improvements in maintenance,								
	ply functions in contingency support.	transportation, and							
	Y 2009: Develop organizational-level change templates for effective application	s of net-based							
	stics operations. Validate these change templates in operational settings (e.g., air								
logis	stics readiness centers) for effective implementation of advanced automation tech	nologies.							
(U)									
	JOR THRUST: Develop and demonstrate cognitive-based analytic and design n		0.132	2.535	1.435	1.958			
	apputer software tools for C2 operations to synchronize personnel in distributed loo								
	red understanding of the C2 battlespace. Increasingly, C2 personnel operate in a rmation environment that inhibits situation understanding and complicates opera	-							
	ision-making. This decision support technology exploits an emerging work-center								
	cept having the potential to rapidly configure common visualizations of C2 opera								
	ision-making.								
(U) In F	Y 2006: Defined the concept of a collaborative toolkit for battle management C	2. Established and							
	umented requirements for an advanced C2 workstation that integrates the battle n	nanagement							
	alization and collaborative tools.								
	Y 2007: Begin to analyze the work aiding requirements for specific distributed (								
-	d course of action development teams supporting global operations. Begin to app k-centered user interface concept to develop shared visualizations and decision s								
	chronizing global operations involving distributed C2 resources such as for the dy	**							
	ir refueling operations.								
	R-1 Line I	tem No. 24							
Project 28	830 Page-	9 of 23			Exhibit R-2a (	PE 0603231F)			

Γ	Exhibit R-2a, RDT&E Project Justification February 2007							
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Sys Personnel Protectio	PROJECT NUM 2830 Decision Technology	ess				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2008: Continue to analyze the work aiding requirements for specific distribution for rapid course of action development teams supporting global operations, to include planning and execution. Conduct experiments to test and evaluate the ability of the interface services approach to provide effective visualizations and decision support operations.	ude coverage both for le work-centered user t for global C2						
(U)	In FY 2009: Refine the methods and techniques to decrease the analysis, design a of providing work-centered support services for global C2 operations. Demonstra global C2 operations that geographically distributed personnel can develop a share understanding of the C2 battlespace.	te in a simulation of						
(U) (U)	MAJOR THRUST: Develop and demonstrate human protective system technolog missions. Technologies will improve aircrew comfort, resulting in increased perfo 2008, this effort is discontinued to align work with higher AF priorities.		0.272	0.682	0.756	0.000		
(U)	In FY 2006: Developed aircrew safety technologies to support long duration miss development of optimized seat system technologies to improve safety, comfort, ar							
	In FY 2007: Continue research on optimizing seat system technologies to improv performance. Develop and evaluate candidate seat system optimization technolog fatigue and discomfort, while maintaining spinal alignment. Extend design conce accommodation of the full aircrew population.	e safety, comfort, and ies that reduce aircrew pts to ensure						
(U)	In FY 2008: Validate system specification through testing of candidate seat system research and development of seat system technologies to improve performance, sa	-						
(U) (U)	Demonstrate performance of candidate seat system optimization technologies. In FY 2009: Not Applicable.							
(U) (U)	MAJOR THRUST: Develop and demonstrate technologies for improved force pro- maintenance of peak warfighter performance in known toxic environments or unce environments during deployment. Develop capabilities for real-time human moni- the identification of toxic substance exposure before the warfighters' health and co- compromised. Note: This major thrust is a continuation of previous work in PE (	haracterized toring in the field and ombat effectiveness are	0.000	0.000	0.898	2.089		
	In FY 2006: Not Applicable.							
(U)	In FY 2007: Not Applicable.							
Pro		ne Item No. 24 ge-10 of 23			Exhibit R-2a (I	PE 0603231F)		
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	Exhibit R-2a, RDT&E Project Justification February 2007								
	GET ACTIVITY .dvanced Technology Development (ATD)		E NUMBER AND TITLE 603231F Crew Systems and ersonnel Protection Technology		PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Technology				
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U)	In FY 2008: Begin development of detection technologies to identify kidney and lidegradation using streamlined, yet robust, assay procedures and biomarkers. General and integration algorithms that fuse varied biomarker data. Multiple specific biomearly detection of low level toxic exposure of deployed forces.	erate selection criteria							
(U)	In FY 2009: Continue development of biomarker based detection technologies. D collecting human biosample input in the field. Develop new concepts for lightwei devices that are operable by non-medical personnel for demonstration of the analy techniques. These technologies will identify potentially threatening toxic exposure protect AF personnel.	ght monitoring sis and detection							
(U) (U)	CONGRESSIONAL ADD: Air Force Advanced Micro-Compression Sock (AFA	MS)	1.446	0.996	0.000	0.000			
(U) (U)	In FY 2006: Conducted Congressionally-directed effort for AFAMS.	MIS).	1.440	0.990	0.000	0.000			
` '	In FY 2007: Conducted Congressionally-directed effort for AFAMS.								
· ·	In FY 2008: Not Applicable.								
• •	In FY 2009: Not Applicable.								
(U)									
(U)	CONGRESSIONAL ADD: Variable Transmittance Visor.		0.966	0.996	0.000	0.000			
(U)	In FY 2006: Conducted Congressionally-directed effort for Variable Transmittance								
	In FY 2007: Conduct Congressionally-directed effort for Variable Transmittance	Visor.							
	In FY 2008: Not Applicable.								
	In FY 2009: Not Applicable.								
(U)	CONCRESSIONAL ADD, Phaser Bird Halmot Treaker (providualy titled New C	Semanation Halmat	0.066	1.296	0.000	0.000			
(U)	CONGRESSIONAL ADD: Phasor-Bird Helmet Tracker (previously titled Next C Tracking and Display Technology).	reneration mennet	0.966	1.290	0.000	0.000			
(U)	In FY 2006: Conducted Congressionally-directed effort for Next Generation Heln	net Tracking and							
(0)	Display Technology.	let Hueking and							
(U)	In FY 2007: Conduct Congressionally-directed effort for Phasor-Bird Helmet Tra	cker.							
	In FY 2008: Not Applicable.								
	In FY 2009: Not Applicable.								
(U)									
(U)	CONGRESSIONAL ADD: Field Deployable Influenza Genotyping System.		0.000	0.996	0.000	0.000			
Proj		e Item No. 24 e-11 of 23			Exhibit R-2a (F	PE 0603231F)			

Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems Personnel Protection Te	and	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Technology		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>	]	FY 2006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2006: Not Applicable.					
(U) In FY 2007: Conduct Congressionally-directed effort for Field Deployable Influenz	a Genotyping				
System.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U) (II) CONCRESSIONAL ADD: Low Cost Improved Performance Halmet Display		0.000	1.096	0.000	0.000
<ul><li>(U) CONGRESSIONAL ADD: Low Cost Improved Performance Helmet Display.</li><li>(U) In FY 2006: Not Applicable.</li></ul>		0.000	1.090	0.000	0.000
(U) In FY 2007: Conduct Congressionally-directed effort for Low Cost Improved Perfor	rmance Helmet				
Display.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
(U)					
(U) CONGRESSIONAL ADD: Virtual Medical Trainer.		0.000	2.192	0.000	0.000
(U) In FY 2006: Not Applicable.					
(U) In FY 2007: Conduct Congressionally-directed effort for Virtual Medical Trainer.					
(U) In FY 2008: Not Applicable.					
(U) In FY 2009: Not Applicable.					
		0.000	0.005	0.000	0.000
(U) CONGRESSIONAL ADD: Deployment Environmental and Biological Surveillanc	e (DEBS).	0.000	0.996	0.000	0.000
(U) In FY 2006: Not Applicable.					
<ul><li>(U) In FY 2007: Conduct Congressionally-directed effort for DEBS.</li><li>(U) In FY 2008: Not Applicable.</li></ul>					
(U) In FY 2009: Not Applicable.					
(U)					
(U) Total Cost		22.425	30.684	19.513	20.189
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>					
<u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2</u>	<u>2009 FY 2010 FY 201</u>	<u>11 FY 2012</u>	<u>FY 2013</u>	Cost to	
	mate Estimate Estim			Complete	Total Cost
(U) Related Activities:	<u>Lotinute</u> Lotin	<u>Estimate</u>	<u>Listinate</u>	complete	
(U) $PE 0602202F$ , Human					
	Item No. 24				
	-12 of 23			Exhibit R-2a (F	PE 0603231F)
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Exhibit R-2a, RDT&E Project Justification February 2007						
UDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE					
<ul> <li>J) <u>C. Other Program Funding Summary (\$ in Millions)</u> Effectiveness Applied Research.</li> <li>J) PE 0604706F, Life Support Systems.</li> <li>J) This project has been coordinated through the Reliance 21 process to</li> </ul>		•				
<ul> <li>harmonize efforts and eliminate duplication.</li> <li><b>D. Acquisition Strategy</b> Not Applicable.</li> </ul>						
Project 2830	R-1 Line Item No. 24 Page-13 of 23		Exhibit R-2a (PE 0603231			

	Exhibit R-2a, RDT&E Project Justification February 2007									2007	
	T ACTIVITY vanced Technology Developme	ent (ATD)			06032	IBER AND TITL 31F Crew Sy nnel Protect	stems and	49	ROJECT NUMBE 24 Warfight chnology	ER AND TITLE er Readines	S
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4924	Warfighter Readiness Technology	7.688	9.274	6.249	6.682	6.602	6.043	6.429	6.412	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
T ru v a n ii	A. Mission Description and Budget This project develops and demonstrate eadiness by enhancing operator and to veapon systems, and weapon systems erospace operations. This project dev hission training and mission rehearsal neterconnection, information, visual, a ompetencies of combat and combat s	es advanced tra eam performan simulators to p velops and der capabilities. nd representat	aining, simulation nee skills. Thi portray the glob nonstrates adv Development ion technologi	s effort inclue bal battlespac anced trainin and effective ies. The resul	des the develop e, including al g and simulati- use of the glob lting mission to	pment of techn l-weather, day on technologid bal battlespace raining and rel	nologies that e //night flight o es that will im e requires adva	enable integra operations, C2 prove warfight ances in traini	tion of compu 2, force protect nter readiness ing systems an	ter models, liv tion, and by enhancing id in	e
(U) M t f (U) I t	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Advance aerospa raining and rehearsal. These compute protection, and air base defense warfig efficiency, and decrease time to mission n FY 2006: Demonstrated the perfor- pattlefield air operations toolkit training	ce and organiz er agents and r ghters. Techn on qualification mance evaluating ng devices into	zational behav models will ad ologies will in on. tion and tracki o an immersive	d realism ope crease trainin ng system. In e, Distributed	erations, C2, for g effectivenes ntegrated the c Mission Oper	orce s and urrent rations	<u>FY 20</u> 2.1		<u>Y 2007</u> 3.007	<u>FY 2008</u> 3.108	<u>FY 2009</u> 3.100
r (U) I r I c t	DMO) compatible training system, can nission planning toolset for a deploya levelop tactical scenarios and to employ n FY 2007: Develop interface parama anges. Develop a proof of concept jo Develop preliminary exercise planning exapability that reduces training develop echnologies and methods for a deploy lemonstration in a persistent wargami	ble, modest fi loy constructiv leters to link E bint close air s g and analysis ppment time. I yable training	delity environ ve forces, live DMO mission to upport schoolly shells to enab Develop perfor environment.	ment that per players, or oth raining center nouse simulati le a robust sc rmance measu Perform a sm	mits training d her virtual play rs and live trai ion environme enario authori urement/monit nall-footprint t	lesigners to yers. ning nt. ng toring raining					
f (U) I	or managing learning in distributed to n FY 2008: Develop integrated meth constructive environments. Develop a ir-to-ground, close air support, and C	raining contex ods for assess and demonstra	ts. ing and trackin te integrated r	ng performan eadiness asse nd training cap	ce in live, virtu ssment for air-	ual, and to-air, en DMO					
Proje	ct 4924				Page-14 of 23 458					Exhibit R-2a (P	E 0603231F)

	Exhibit R-2a, RDT&E Project Just		DATE	February	2007	
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Syst Personnel Protectio			ABER AND TITLE Inter Readines	SS
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> and live range exercises. Continue development of scenario authoring shells amenab training and learning in virtual and live contexts. Develop integrated methods for ev of different levels of fidelity in simulation environments on performance and readine development of functional requirements for managing learning in distributed training	aluating the impact ss. Finalize the g contexts.	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Demonstrate adaptive training within DMO using embedded knowledg assessment. Develop common tools for mission planning, briefing, and after action a across air combat, ground operations, and combat operations and planning in an AOG integration and evaluation of joint close air support environment for schoolhouse trait technology alternatives for in-garrison and field deployable joint close air support tra- development of specifications for integrating forward deployed battlefield coordinatis simulation with joint close air support schoolhouse training. Demonstrate embedded performance assessment in a deployed combat training environment.	review that function C. Complete ning. Evaluate ining. Initiate on and command				
(U) (U)	MAJOR THRUST: Develop a low-cost, deployable visual simulation system with suresolution and performance capable of supporting the imaging of high-resolution fast high-density terrain, texture, surround imagery, and helmet-mounted sights. This texture provide the warfighter realistic air-to-air and air-to-ground visual simulation environ aircrew training during expeditionary deployments and at mission training centers.	t-moving targets, hnology will	0.793	1.154	1.284	1.150
(U)	In FY 2006: Designed and developed off-boresight targeting simulation for DMO m simulator displays. Defined display design requirements for head-mounted and deple devices, defined next generation design configurations, and evaluated alternative displayed and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon	oyable training				
(U)	In FY 2007: Begin development of advanced, ultra resolution head-mounted and dep Immersive Visual Environment (CIVE) proof-of-concept display components. Begin human factors analyses of the display components.	ployable Compact				
(U)	In FY 2008: Continue engineering and human factors analyses of the CIVE display generation components to assess feasibility of new scanning architectures, image fide portability, resolution, size, weight, transport delay, and user acceptance.	-				
(U) (U)	In FY2009: Develop a CIVE technology demonstrator. Begin evaluation and valida technology demonstrator.	tion of the				
(U)	MAJOR THRUST: Develop and demonstrate training technologies and techniques t	o optimize night	1.619	0.724	0.000	0.000
Pro	ject 4924 Page-	tem No. 24 15 of 23 59			Exhibit R-2a (F	PE 0603231F)

	Exhibit R-2a, RDT&E Project Justification February 2007								
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE Ogy Development (ATD) Personnel Protection Technology				<b>S</b> S			
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> vision device-aided night operations. These technologies could reduce the co (NVG) qualification and increase combat capability. Note: In FY 2008, this higher AF priorities. In FY 2006: Developed desktop NVG visualization trainer for mission previo	s effort terminates due to iew and mishap	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
	investigation applications. Developed NVG mission brief/debrief technolog spatial orientation training protocols. Developed and evaluated performance instrument scan, cross-check, and spatial orientation. Developed formats for material properties-coded datasets suitable for NVG and other sensor simula evaluated physics-based simulation approach in a variety of visual displays. board instructional module for introductory NVG academic training.	e metrics for NVG reusable and interoperable tion. Developed and Developed virtual terrain							
(U)	In FY 2007: Develop NVG simulator scenarios and related performance me employment training. Develop geo-specific databases and database modificat visualization training. Test simulated panoramic NVG in DMO testbed. De simulation for NVG video and head position by application of broadband with Demonstrate head position driven simulated NVG imagery viewable by multi- space.	ation tools for desktop NVG velop untethered NVG reless technology.							
	In FY 2008: Not Applicable. In FY 2009: Not Applicable.								
• •	MAJOR THRUST: Develop and demonstrate a high-fidelity DMO training operators in an Air and Space Operations Center (AOC). Link AOC operation and performance metrics to develop team learning environments for AOC ur demonstrate high-fidelity, interactive Electronic Warfare (EW) training techn live-virtual-constructive training networks for future threat systems/capability platforms and weapons systems. These technologies provide AF, Joint, and more realistic EW mission training and rehearsal environments that accurate threats, thereby increasing operational readiness and capability.	onal mission requirements hits. Develop and nologies for use with lies and advanced sensor coalition warfighters with	1.497	2.098	1.857	2.432			
(U)	In FY 2006: Developed performance indicators to enable performance measurements and individual-level AOC operators. Developed initial functional spectromputer-assisted training scenario for AOC operators. Enhanced training steam- and individual-level AOC operators based on current scientific and context.	cifications for yllabi and methods for							
	ject 4924	R-1 Line Item No. 24 Page-16 of 23			Exhibit R-2a (I				

	Exhibit R-2a, RDT&E Project Jus	stification		DATE	February	2007
	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Syste Personnel Protection			IBER AND TITLE hter Readines	SS
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Developed AOC training and rehearsal capabilities within the larger DMO training	and rehearsal				
лD	environment. In FY 2007: Develop a proof-of-concept multi-team competency-based training pa	ckage with				
(0)	performance assessment system capability for the AOC. Develop initial competence	•				
	selection guidelines and conduct a proof-of-concept test of competency-based scena					
	capability for operational planners. In FY 2008: Develop competency-based training requirements for team and function	anal areas within				
(U)	strategy and plans divisions including IO and ISR teams. Develop optimum training					
	rehearsal strategies to employ information simulation into AOC weapon systems p	-				
	Survey instructional methods for employment in targeted training of mission-essen	-				
	skills and develop most capable method(s) for integration. Begin the design and de	•				
	architectures and hardware that integrate live EW range data into shared networked	-				
	the development of a simulation of an advanced fighter-specific EW sensor suite for					
	Demonstrate guiding a single EW training illuminator on a live electronic combat r	ange with fully				
	integrated, computer-generated, and live forces.					
(U)	In FY 2009: Develop integration methods for fielded and emerging systems and ap team, inter-team and division-level event specifications for mission qualification tra					
	continuation training scenarios. Validate environment approaches through exercise					
	capture, and analysis to define quality of experience, spectrum of training capability					
	assessment capabilities. Complete live EW range integration into DMO. Develop					
	advanced platform-specific EW sensor suite for DMO. Develop a proof-of-concep					
	integrating multiple EW suite simulations with a synthetic threat environment feature	ring advanced				
	missile fly out models and basic directed energy threats. Begin measuring and value					
	in EW training using these technologies and techniques. Begin the development of					
	improved, embedded EW training capability on airborne aircraft and design system	s and demonstrate				
(U)	these technologies during a live-fly exercise at an EW training range.					
	CONGRESSIONAL ADD: Air Operations Center Secured Data Access.		1.640	0.000	0.000	0.000
	In FY 2006: Conducted Congressionally-directed effort for Air Operations Center	Secured Data	2.010		5.000	0.000
È	Access.					
(U)	In FY 2007: Not Applicable.					
Dre		Item No. 24				
Proj		-17 of 23 461			Exhibit R-2a (I	~⊑ 0603231F)

	Exhibit	t R-2a, RD⊺	F&E Projec	t Justifica	tion			DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Deve	lopment (ATD	)		0603	UMBER AND TI 3231F Crew S sonnel Prote	Systems and	ology	PROJECT NUMB 4924 Warfight Technology	ER AND TITLE	
<ul> <li>(U) <u>B. Accomplishments/Planned</u></li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	<u>Program (\$ in</u>	<u>Millions)</u>				<u>FY 2</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Au</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Conduct Congress</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>		0		Flight Simula	tor for JSF.	0.0	000	1.295	0.000	0.000
<ul> <li>U)</li> <li>U) CONGRESSIONAL ADD: Da</li> <li>U) In FY 2006: Not Applicable.</li> <li>U) In FY 2006: Conduct Congress</li> <li>U) In FY 2008: Not Applicable.</li> <li>U) In FY 2009: Not Applicable.</li> </ul>	_		abase Integration	on Tools.		0.0	000	0.996	0.000	0.000
(U) (U) Total Cost						7.0	588	9.274	6.249	6.682
<ul> <li>(U) <u>C. Other Program Funding Sectors</u></li> <li>(U) Related Activities:</li> <li>(U) PE 0602202F, Human Effectiveness Applied Research.</li> <li>(U) PE 0604227F, Distributed Mission Training.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>	<u>ummary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimat		<u>Cost to</u> Complete	Total Cost
Project 4924			F	R-1 Line Item No Page-18 of 23						PE 0603231F

Exhibit R-2a, RDT&E	Project Justification	DATE February 2007		
JDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	T NUMBER AND TITLE		
J) <b><u>D. Acquisition Strategy</u></b> Not Applicable.				
	R-1 Line Item No. 24			
roject 4924	Page-19 of 23 463	Exhibit R-2a (PE 060323		

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
		ent (ATD)			06032	31F Crew Sy	stems and	5	020 Bioeffec		ion
	February 200           Budget ACTIVITY         Pebulage 200           Pebulage 200           Solution of the expension of the		2010 FY 2011 FY 2012		Total						
	· · · ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5020	Technology									Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0 0		
	vigilance, or mission effectiveness, ar technologies for laser eye protection ( laser weapons, and enabling operation high-energy laser systems and techno developed and demonstrated to enable	nd man-portabl (LEP), preventi- nal employmen logies to enhan	e technologies ing injurious e at of these syst ace personnel s	s for the neutrax posures of pe ems. It also d safety and effe	alization of the ersonnel invol levelops tools ectiveness in a	reats. Develop ved with test a and guidelines erospace oper	oment and der and evaluatior s for testing ar ations. Biobe	nonstration of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies of high poventies	efforts focus on ver microwave high power mi formance capab	advanced or high-energ crowave and bilities are	
(U)	MAJOR THRUST: Develop and der ground personnel to provide protection effort completes in FY 2007.	nonstrate multion against any l	iwavelength L laser hazard o	threat in a sin	ngle device. N	lote: This					<u>FY 2009</u> 0.000
	Continued development of an integra protection while restoring vision degr wrap-around LEP spectacle technolog	ted LEP demon raded by the LI gy with prescri	nstration syste EP to better th ption capabili	m to provide : an normal. In ties.	full-spectrum	laser pment of					
	second-generation LEP goggles for S	-	• •	-							
	In FY 2009: Not Applicable.										
	MAIOR THRUST. Develop and dar	nonstrata tachr	nologies that n	ermit safe tost	ting deployme	ant and use	03	74	0.820	0 008	0.757
(0)	-		iorogies that p	ernin sale iesi	ung, acpioying	in, and use	0.5	/ - 1	0.020	0.200	0.151
• •	In FY 2006: Integrated existing mod	els of airborne		gth-specific d	ose-response o	curves to					
	1		•	of additional n	nultiple-wavel	ength					
Proje	ect 5020				Line Item No. 24 Page-20 of 23	4				Exhibit R-2a (F	PE 0603231F)

	Exhibit R-2a, RDT&E Project J	Justification		DATE	February	2007
	ACTIVITY anced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Syst Personnel Protectio		PROJECT NUM 5020 Bioeffe Technology	tion	
exj	Accomplishments/Planned Program (\$ in Millions) posures to airborne laser wavelength and other near-infrared laser beams to de resholds of the combined exposures when compared to their single-wavelengt	-	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
dis acc	FY 2008: Release laser range safety software tool including dynamic bi-dire stribution function to support live fire test of major systems. Initiate validatio creditation package for new software package Continue assessment of probat r use with laser hazard assessment.	n, verification, and				
Re	FY 2009: Complete validation, verification, and accreditation package for la elease collateral hazard assessment software tool to enable analysis of tactical ser systems.					
rac	AJOR THRUST: Develop and demonstrate technologies to assess bioeffects dio frequency (RF) systems, including terahertz technologies. Note: This manutinuation of previous work in PE 0602202F.		0.000	0.000	0.888	1.581
	FY 2006: Not Applicable.					
	FY 2007: Not Applicable.	·				
	FY 2008: Initiate program to develop solutions for both laser and other non- rsonnel. Integrate laser solutions into solutions for RF, microwave, terahertz,	-				
-	ectromagnetic radiation for personnel protection.	and other regimes of				
(U) In pro ter des	FY 2009: Continue to develop laser and RF and other non-ionizing protective otection. Continue integration of laser protective technologies with those for rahertz, and other regimes of electromagnetic radiation for personnel protection sign specifications for directed energy protective equipment. Continue long-te eapon systems effects.	RF, microwave, on. Establish preliminary				
(U)						
(U) M.	AJOR THRUST: Develop and demonstrate technologies to support testing of chnologies and to enable man-portable threat neutralization capabilities.	f counterforce	0.437	0.864	0.639	0.167
	FY 2006: Enhanced neutralization technologies to optimize performance for nditions. Conducted laboratory tests to assess performance under simulated of					
(U) In int	FY 2007: Refine and downselect neutralization devices, develop simulated to tegrate with threat detection technologies. Demonstrate most promising man- cutralization technologies in simulated environments.	sting capabilities, and				
Project		Line Item No. 24 Page-21 of 23			Exhibit R-2a (	PE 0603231F)

	Exhibit R-2a, RDT&E Project Ju	stification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Sys Personnel Protection	stems and		IBER AND TITLE ects & Protec	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	In FY 2008: Begin developing technologies that will provide the capability to neuleaving evidence for special applications. Develop technologies to enable safe retrocontaminating aircraft or other equipment. In FY 2009: Continue development of technologies that will provide the capabilit without evidence for special applications. Improve technologies to enable safe retrocontaminating aircraft or other equipment.	rn and avoid y to neutralize threats				
(U)						
(U)	MAJOR THRUST: Develop a fatigue management capability to alleviate the neg- on human performance in aerospace operations. Results will extend and enhance and survivability in sustained and continuous (24/7) mission environments for all a operations, maintenance, and space operators. Note: This effort completes in FY	human performance wiation, C2, special	0.940	0.652	0.361	0.000
(U)	In FY 2006: Integrated modeling of specific fatigue effects and interventions into management capability. Improved and demonstrated operational usability of fatig capability. Expanded fatigue model capability to predict operational task performs shiftwork ambiantions.	ue management				
(U)	shiftwork applications. In FY 2007: Integrate biobehavioral performance model for selected military task crew scheduling and special forces mission planning.	s, such as airlift/tanker				
(U)	In FY 2008: Complete development and demonstrate quantitative biobehavioral p management tools to provide scheduling solutions and operational risk manageme extend and enhance human performance in sustained and continuous (24/7) militar	nt calculations to				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Full Spectrum Laser Eye Protection.	The Drotaction	0.966	0.996	0.000	0.000
(U) (U)	In FY 2006: Conducted Congressionally-directed effort for Full Spectrum Laser F In FY 2007: Conduct Congressionally-directed effort for Full Spectrum Laser Eye	•				
(U)	In FY 2008: Not Applicable.	i i lottettoll.				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	Total Cost		3.457	3.932	2.796	2.505
Pro		e Item No. 24 e-22 of 23			Exhibit R-2a (	PE 0603231F)
· · · · · ·		466				

	Exhibit	: R-2a, RD	C&E Projec	t Justificat	tion			DATE	ebruary 2007
BUDGET ACTIVITY 03 Advanced Technology Develo	opment (ATD	)							R AND TITLE s & Protection
(U) <u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u>	<u>(fillions)</u>							
	FY 2006 Actual	FY 2007 Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimate		<u>Cost to</u> <u>Complete</u> <u>Total Cost</u>
<ul> <li>(U) PE 0602102F, Materials.</li> <li>(U) PE 0602202F, Human Effectiveness Applied Research.</li> </ul>									
(U) PE 0603112F, Advanced Materials for Weapon									
Systems. (U) PE 0603319F, Airborne Laser									
Program. (U) PE 0604706F, Life Support Systems.									
<ul> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>									
(U) <b>D. Acquisition Strategy</b> Not Applicable.									
Project 5020			ł	R-1 Line Item No. Page-23 of 23				1	Exhibit R-2a (PE 0603231F)
,				467					

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#### PE NUMBER: 0603270F PE TITLE: Electronic Combat Technology

Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
BUDGET ACTIVITY <b>3 Advanced Technology Developme</b>	ent (ATD)				BER AND TITL <b>70F Electror</b>	E nic Combat <sup>-</sup>	Technology		<u> </u>	
	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Cost (\$ in Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cost	32.247	28.528	23.743	21.287	23.832	25.862	26.376	26.939	Continuing	TBI
2432 Defensive System Fusion Technology	7.367	5.163	5.398	5.943	6.931	7.862	8.908	7.293	Continuing	TBI
431G RF Warning & Countermeasures Tech	9.264	9.352	7.743	6.862	8.460	7.774	7.043	9.007	Continuing	TBI
691X EO/IR Warning & Countermeasures Tech	15.616	14.013	10.602	8.482	8.441	10.226	10.425	10.639	Continuing	TBI
This program develops and demonstrates components, subsystems, and technological develops and demonstrates technological advanced technologies for radio freque electro-optical, infrared, and laser three Missile Warning System; and \$1.3 mill demonstrates technologies for existing	ogies with pote es for integration ency EC suites ats to aerospace lion for BLAI	ential aerospacing EC sensors. The third proce platforms. DES. This pro	e combat, spe s and systems oject develops Note: In FY 2 ogram is in Bu	cial operation into a fused and s and demonst 007 Congress dget Activity	s, and airlift E nd seamless w rates advance added \$1.0 m 3, Advanced 7	C application hole. The sec d warning and hillion for RAF Fechnology D	s in three projected cond project de l countermeass PCEval; \$1.9 r evelopment, s	ect areas. The evelops and de ure technologi nillion for Aff ince it develop	first project emonstrates es to defeat ordable Visiblos and	le
U) <u>B. Program Change Summary (\$ in</u>					<u>r</u>		<i>yy</i>	8-		
					<u>FY 20</u>		<u>FY 2007</u>		2008	<u>FY 2009</u>
U) Previous President's Budget					33.3		24.436		4.857	26.978
U) Current PBR/President's Budget					32.2		28.528	2	3.743	21.287
U) Total Adjustments					-1.0	)95				
U) Congressional Program Reductions										
Congressional Rescissions					-0.0	002	-0.108			
Congressional Increases							5.200			
Reprogrammings					-0.3		-1.000			
SBIR/STTR Transfer					-0.7	740				
U) <u>Significant Program Changes:</u> Not Applicable.										
C. Performance Metrics										
				Line Item No. 28 Page-1 of 13	5				Exhibit R-2 (Pl	E 0603270F)
				469 CLASSIFIE						_ ========

Exhibit R-2, RDT&E Bu	dget Item Justification	DATE February 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Te	
Under Development.		
	Did Line Harris No. 05	
	R-1 Line Item No. 25 Page-2 of 13 470	Exhibit R-2 (PE 0603270F)

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
		ent (ATD)			06032	70F Electro		24	32 Defensiv		ision
	February 20           Get ACTIVITY           Advanced Technology Development (ATD)         PE NUMBER AND TITLE Defensive System Fusion         PROJECT NUMBER AND TITLE Defensive System Fusion           Cost (\$ in Millions)         FY 2006 Actual         FY 2007 Estimate         FY 2010 Estimate         FY 2011 FY 2012 FY 2012 Technology           Cost (\$ in Millions)         FY 2006 Actual         FY 2007 FY 2007 Technology         FY 2010 FY 2017 FY 2017 Technology         FY 2017 FY 2013 Cost to Cost to Complete System Fusion         Cost (\$ in Millions)         FY 2006 To 0         FY 2017 FY 2013 Cost to Complete System Fusion         Cost to Complete Malos RDT&EE Articles         0         O         Cost to Complete System Fusion         Cost to Cost to Completed for completed and control nodes and networks. Note: This effort completes in FY 2006         FY 2006 System Fusion										

	Exhibit R-2a, RDT&E P	roject Justification		DATE	February	2007	
	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electroni Technology			UMBER AND TITLE nsive System Fusion Gy		
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2007: Complete risk reduction for defensive sensors using multi- situational awareness in the IDAL. Complete IDAL laboratory risk re- demonstrations that evolve and optimize network EA techniques on di- demonstrations of advanced multiplatform digital receiver and process warfighter with multispectral warning, identification, and threat respon- aerospace platforms. In FY 2008: Not Applicable.	duction evaluations and sparate platforms. Perform for technologies that provide the	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U)	In FY 2009: Not Applicable. MAJOR THRUST: Develop affordable radio frequency (RF) and elect concepts and techniques. Develop techniques for coordination and ma nodes against integrated air defense systems (IADS). Conduct integrat information operations (IO) simulations and demonstrations for integra deception and defeat.	ted electronic warfare (EW)/ ated air defense systems (IADS)	4.016	4.465	5.398	5.943	
(U)	In FY 2006: Designed and initiated demonstration of advanced threat combat aircraft to increase survivability against advanced, integrated I defense systems. Performed initial flight tests to select advanced jammimproved digital threat warning and response capability.	RF, EO, and infrared (IR) air					
(U)	In FY 2007: Complete engineering model demonstration of advanced subsystem for combat aircraft to increase survivability against advanced defense systems. Perform final flight tests to validate advanced jamm improved digital threat warning and response capability.	ed, integrated RF, EO, and IR air					
(U)	In FY 2008: Complete maturation demonstration of advanced threat a combat aircraft to increase survivability against advanced, integrated I systems. Investigate electronic warfare (EW) battle management strat control of multiple jamming nodes working in coordination against an non-traditional intelligence, surveillance, and reconnaissance and strik demonstrate technical protocols for the integration of EW, C2W, and I	RF, EO, and IR air defense egies and technical protocols for IADS in the overall context of e operations. Develop and					
(U)	In FY 2009: Conduct analyses and initial demonstrations of EW battle IDAL and VCL simulation facilities. Continue to develop and demon integration of EW, C2W, and IO operations against an IADS.	e management strategies in the					
i i		R-1 Line Item No. 25					

		Exhibit	t R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007
	GET ACTIVITY Advanced Technology Devel	opment (ATD	)		0603	UMBER AND TI 3270F Electro hnology			PROJECT NUME 2432 Defensi Technology		usion
(U)	<b>B. Accomplishments/Planned</b>	<u>Program (\$ in</u>	Millions)				<u>FY 2</u>	006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	CONGRESSIONAL ADD: Ad Technology Insertion. In FY 2006: Conducted Congre Insertion.						1.9	927	0.000	0.000	0.000
(U) (U) (U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.										
(U)	Total Cost						7.	367	5.163	5.398	5.943
(U) (U)	C. Other Program Funding Su Related Activities: PE 0602204F, Aerospace Sensors. PE 0603203F, Advanced Aerospace Sensors. PE 0603500F, Multi-disciplinary Advanced Space Technology.	<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	FY 2008 Estimate	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimat	_	Cost to Complete	I otal Cost
	PE 0604270F, Electronic Warfare (EW) Development. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										
(U)	<b>D. Acquisition Strategy</b> Not Applicable.										
Pro	pject 2432			I	R-1 Line Item No Page-5 of 13					Exhibit R-2a (I	PE 0603270F)

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY dvanced Technology Developme	ent (ATD)				IBER AND TITL 70F Electroi ology		43	OJECT NUMBE 1G RF Warn puntermeasu	ing &	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4310	RF Warning & Countermeasures Tech	9.264	9.352	7.743	6.862	8.460	7.774	7.043	9.007	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	A. Mission Description and Budget This project develops and demonstrate vehicles and to provide crew situation sorting/preprocessing algorithms, and development and demonstration of sub electronic countermeasures (ECM) tec	es advanced te al awareness. expert softwar bsystems and c	chnologies for One major are re for application components for	ea addresses to ons on existir r generating o	echnologies for ng and future l on-board/off-b	or missile/threa EC systems. A oard RF count	at warning, RF Another major termeasure tec	receivers, EC technology ar hniques. This	c preprocessor rea focuses on s includes the	rs, advanced the	of
(U) (U) (U) (U) (U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop widebar applications (i.e., threat detection, threat reconnaissance). Note: This effort co In FY 2006: Designed and fabricated frequency, wide band aperture compa In FY 2007: Test critical subsystems array compatible with UAV platforms In FY 2008: Complete integration an In FY 2009: Not Applicable.	nd, multi-mode eat avoidance, mpletes in FY critical apertu tible with unm of an efficient s.	e, multi-functi suppression o 2008. are and receive anned aerial v , low frequence	f enemy air de er subsystems rehicle (UAV) cy, wide band	efenses, surve for an efficier ) platforms. aperture, and	illance, and it, low	<u>FY 20</u> 1.5		<u>7 2007</u> 1.557	<u>FY 2008</u> 1.165	<u>FY 2009</u> 0.000
(U)	MAJOR THRUST: Develop aerospace techniques to counter advanced RF th Develop coordinated, multi-player race warning and surveillance networks to Develop new electronic attack (EA) to digital technique generators. In FY 2006: Developed self-protection surface-to-air missile systems. Developed	reats associate lar jamming te enable all-plat echniques fusit	d with current echniques for o tform operation ng advanced d sures effective	and future ae leception and ns in defende- igital signal p against fourt	erospace weap neutralization d adversary ai processing rece h generation	on systems. of early rspace.	5.7	71	6.799	6.578	6.862
	countermeasures techniques and techn Laboratory- and field-tested innovativ	nology to defea	at an advanced	l integrated ai asure techniqu R-1	r defense syst	vanced				Exhibit R-2a (P	E 0603270F)
					474						

	Exhibit R-2a, RDT&E Project Ju	ustification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Technology	PROJECT NUM 431G RF Wa Countermea	IBER AND TITLE		
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)	duon and DE sonson	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	target engagement radars. Developed anti-jam techniques and technologies for a systems. Demonstrated a lightweight, low-profile, multi-function, active electror					
	an airborne test bed. Analyzed data from flight test and predicted system perform computational techniques.					
(U)	In FY 2007: Continue developing self-protection countermeasures effective again	nst advanced future				
	surface-to-air missile systems. Complete laboratory and field-testing of innovativ					
	countermeasure techniques against advanced target engagement radars. Complet advanced countermeasures techniques and technology to defeat an advanced IAD	_				
	developing anti-jam techniques and technologies for advanced RF sensor systems					
	demonstration of electronic support cross-cueing capabilities of a multi-intelliger	-				
	including the effects of electromagnetic interference and platform compatibility t	o provide precision				
	location and identification with increased probability of intercept.					
(0)	In FY 2008: Provide hardware simulation and analysis support to multi-intellige accurate and timely electronic surveillance information. Conduct threat research					
	analysis of early warning radar characteristics. Develop multiple technical strate					
	deceiving early warning radars in a network enabled operational environment. D	evelop advanced				
	simulation capabilities to support network enabled jamming of adversary early w	-				
	networks. Develop and evaluate integrated digital receiver/jammer architectures.					
(U)	In FY 2009: Continue to provide hardware simulation and analysis support to me needs for accurate and timely electronic surveillance information. Develop adva	-				
	engineering models including technique generators, wide band amplifier modules	· ·				
	to conduct network enabled research and evaluation of countermeasure technique	-				
	advanced simulation capabilities to support network enabled jamming of adversa					
	surveillance networks. Continue to develop and evaluate integrated digital receiv architectures.	er/jammer				
(U)	architectures.					
(U)	CONGRESSIONAL ADD: Electronic Combat Battle Management.		0.964	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Electronic Combat E	attle Management.				
	In FY 2007: Not Applicable.					
· · ·	In FY 2008: Not Applicable.					
$(\mathbf{U})$	In FY 2009: Not Applicable.					
Pro		ne Item No. 25			Exhibit R-22 (P	F 0603270F1
Pro		ne Item No. 25 age-7 of 13 475			Exhibit R-2a (P	E 0603270F)

	Exhibit	R-2a, RDT	&E Projec	t Justifica	tion			DATE	February	2007
BUDGET ACTIVITY <b>3 Advanced Technology Develo</b>	oment (ATD	)		0603	UMBER AND TI 3270F Electro hnology	rle onic Combat		PROJECT NUM 431G RF Wa Countermea	BER AND TITLE	
U) <u>B. Accomplishments/Planned Pr</u>	ogram (\$ in	<u>Millions)</u>				<u>FY 20</u>	006	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Received</li> <li>(U) In FY 2006: Conducted Congression</li> <li>(U) In FY 2007: Conduct Congression</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	onally-direct	ed effort for RA	APCEval.	RAPCEval).		0.9	964	0.996	0.000	0.000
U) Total Cost						9.2	264	9.352	7.743	6.862
<ul> <li>(U) C. Other Program Funding Sum</li> <li>(U) Related Activities:</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0604270F, Electronic Warfare (EW) Development.</li> <li>(U) PE 0603500F, Multi-disciplinary Advanced Space Technology.</li> <li>(U) PE 0604270N, EW Development.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) D. Acquisition Strategy Not Applicable.</li> </ul>	<u>mary (\$ in M</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimat</u>			I OTAL COST
Project 431G			F	R-1 Line Item No Page-8 of 13 476	-				Exhibit R-2a (	PE 0603270F

		Exhibit R-2	2a, RDT&B	E Project 、	Justificatio	on			DATE	February :	2007
	T ACTIVITY vanced Technology Developme	ent (ATD)				MBER AND TITL 70F Electron Iology		69	OJECT NUMBE 1X EO/IR Wa	R AND TITLE	
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
691X	EO/IR Warning & Countermeasures Tech	15.616	14.013	10.602	8.482	8.441	10.226	10.425	10.639	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
T th ro	A. Mission Description and Budget This project develops and demonstrate meats to aerospace platforms. Off-be obust, affordable solutions for protect sed to direct EO, IR, and radar-guide	es the advanced oard (decoys an tion against IR	d warning and d expendable	s) and on-boa	ard countermea	asure technolo	gies develope	d for aircraft s	self-protection	will provide	ns
(U) M s (U) I	<b>3. Accomplishments/Planned Prog</b> MAJOR THRUST: Analyze the vuln ensors. Note: Increased funding in 1 and expendable decoys with modified n FY 2006: Conducted in-house ana	herabilities of c FY 2006 suppo l spatial and ki lyses on IR-gu	urrent IR miss orted field den nematic prope ided missile a	nonstration of rties for coun nd future ima	cooperative to tering IR miss ging IR sensor	echniques iles. r	<u>FY 20</u> 4.1		<u>¥ 2007</u> 2.104	<u>FY 2008</u> 1.905	<u>FY 2009</u> 1.539
(U) I s a t	usceptibilities. Evaluated counterme maging IR sensors. n FY 2007: Continue conducting in- usceptibilities. Further evaluate cou and imaging IR sensors. Conduct dig echniques against imaging IR missile countermeasure techniques to defeat i	-house analyses ntermeasure te gital simulation es under flyout	s on IR guided chniques for c s to assess the conditions. A	l missiles and ountering mu effectiveness	future imagin ltiple types of s of spatial dec	g IR sensor missiles					
(U) I s a	n FY 2008: Conclude in-house analy usceptibilities. Further evaluate cou and imaging IR sensors. Identify opti- ensors.	yses on IR guid ntermeasure te	led missiles a chniques for c	ountering mu	ltiple types of	missiles					
c t	n FY 2009: Perform laboratory anal of current and planned techniques aga echnique requirements. Conduct dig countermeasure techniques.	ainst new threa	t trends and di	rection of fut	ure counterme	asure					
(U) (U) N	MAJOR THRUST: Develop aerospa	ce laser warnir	ng sensor tech	nologies for ti	imely alert to a	advanced	1.9	53	1.840	1.536	1.709
	ot 691X		-	R-1	Line Item No. 2 Page-9 of 13 477					Exhibit R-2a (P	

	Exhibit R-2a, RDT&E Project	t Justification		DATI	February	2007
	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Technology	691X EO/IR	MBER AND TITLE Warning & asures Tech		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> laser acquisition/tracking sensors, including detecting and locating both high and low power (laser-guided ordnance) signals.	power (dazzle/damage)	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2006: Developed advanced laser warning receivers for aircraft. Devel technologies to address emerging laser threats. Developed laser warning sens into UAVs and NVGs.					
	In FY 2007: Initiate development of an advanced laser warning receiver for i aircraft. Continue developing laser warning sensor technologies to address er Initiate miniature laser warning for personnel protection.	-				
(U)	In FY 2008: Continue developing laser warning sensors to address emerging miniaturized laser warning sensors. Fabricate compact device for personnel p capability to geolocate laser threats for enhanced situational awareness.	-				
(U)	In FY 2009: Continue developing laser warning sensors to address emerging development of miniaturized laser warning sensors. Fabricate sensor for sens cueing. Demonstrate capability to cue agile filters for optimized protection as threats.	or and eye protection				
(U)						
(U)	MAJOR THRUST: Develop a countermeasure technology to defeat passive l sensors and ordnance guidance.	EO and IR aircraft tracking	2.897	5.955	5.592	5.234
	In FY 2006: Completed development of testbed to locate and counter passive develop a fire control solution. Conducted field demonstration over extended capability.					
	In FY 2007: Continue field tests to locate and counter passive threats before control solution. Initiate development of a tower demonstration system. Den wide field of regard and locate passive surveillance sensors in real time.	-				
(U)	In FY 2008: Complete field tests to locate and counter passive threats before control solution. Complete tower demonstration system development and con km range. Evaluate effectiveness of countermeasure techniques against night passive surveillance sensors.	nduct experiments over 2 vision devices and other				
	In FY 2009: Initiate development of affordable, lightweight infrared countern combining passive surveillance and missile defeat techniques for tactical aircr compact system to geolocate and identify threats.					
<b>D</b> :-		-1 Line Item No. 25				
Proje	ect 691X	Page-10 of 13 478			Exhibit R-2a (	PE 0603270F

	Exhibit R-2a, RDT&E Project J	ustification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electroni Technology		PROJECT NUM 691X EO/IR Countermea	BER AND TITLE Warning &	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)			0.000	0.02.6	1	0.000
(U)	MAJOR THRUST: Develop EO/IR missile warning technologies to alert aircrev self-protection systems to the approach of advanced, low-signature threats. Note in FY 2008.		0.882	0.926	1.569	0.000
(U)	In FY 2006: Performed integration of subsystem components into affordable vis system (AVMWS). Performed test and evaluation of AVMWS. Coordinated AV with the Affordable Laser Infrared Survivability System countermeasure system.	VMWS development				
ധ	In FY 2007: Complete test and evaluation of AVMWS.					
	In FY 2008: Characterize sensor performance in varied background clutter. Iden	ntify maximum				
	detection ranges for high priority threat missiles.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Detect and Avoid for UAVs.		1.349	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Detect and Avoid fo	r UAVs.				
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Infrared Countermeasures Electronics Improvement	•	0.965	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Infrared Counter Improvement Program.	measures Electronics				
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Affordable Visible Missile Warning System.		2.024	1.893	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for the Affordable Visib	le Missile Warning				
an	System.	N. 1 XX7 '				
(U)	In FY 2007: Conduct Congressionally-directed effort for the Affordable Visible System.	Missile Warning				
(U)	In FY 2008: Not Applicable.					
		ing Itom No. 05				
Pro		ine Item No. 25 age-11 of 13			Exhibit R-2a (F	PE 0603270F)

	Exhibit	R-2a, RDT	&E Projec	t Justifica	tion			DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Developm	ent (ATD)	)		0603	UMBER AND TI 3270F Electro hnology			PROJECT NUMB 691X EO/IR W Countermeas	ER AND TITLE	
<ul> <li>(U) <u>B. Accomplishments/Planned Prog</u></li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	<u>ram (\$ in ]</u>	<u>Millions)</u>				<u>FY 20</u>	<u>006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Battlefie</li> <li>(U) In FY 2006: Conducted Congression</li> <li>(U) In FY 2007: Conduct Congressionall</li> <li>(U) In FY 2008: Not Applicable.</li> </ul>	ally-direct	ed effort for B	LADES.			1.3	349	1.295	0.000	0.000
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U) Total Cost</li></ul>						15.0	616	14.013	10.602	8.482
(U) <u>C. Other Program Funding Summa</u> <u>F</u>	Y 2006	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	FY 2012 Estimate		Cost to	LOTAL COST
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0604270F, Electronic Warfare (EW) Development.</li> <li>(U) PE 0603500F, Multi-disciplinary Advanced Development Space Technology.</li> <li>(U) PE 0604270N, EW Development.</li> <li>(U) PE 0603203F, Advanced Aerospace Sensors.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>	Actual	<u>Estimate</u>	Estimate	Estimate	Estimate	Estimate		e <u>Estimate</u>	Complete	
Project 691X			F	R-1 Line Item No Page-12 of 13 480					Exhibit R-2a (F	PE 0603270F)

Exhibit R-2a, RDT&E	Project Justification	DATE February 2007
UDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 691X EO/IR Warning & Countermeasures Tech
U) <u>D. Acquisition Strategy</u>		
Not Applicable.		
	R-1 Line Item No. 25	
Project 691X	Page-13 of 13	Exhibit R-2a (PE 0603270

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#### PE NUMBER: 0603311F PE TITLE: Ballistic Missile Technology

E	xhibit R-2,	RDT&E Bu	udget Iten	n Justifica	tion			DATE	February 2	2007
UDGET ACTIVITY 3 Advanced Technology Developm	ent (ATD)				BER AND TITL	E Missile Tec	hnology		i ebiuary 2	2007
	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Cost (\$ in Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE) Cost	11.146	9.365	0.000	0.000	0.000	0.000	0.000	0.000	0.000	47.29
091 Missile Electronics	11.146	9.365	0.000	0.000	0.000	0.000	0.000	0.000	0.000	47.29
ote: In FY 1997, the Air Force eliminate	ed this program	. However, C	ongress has a	dded funds for	Congressiona	ally-directed e	fforts since F	<i>č</i> 1997.		
This program develops, integrates, an safety instrumentation. In FY 2007, Ballistic Missile Technology Program demonstrates technologies for existin	Congress addec n, and \$2.4 mill	1 \$1.8 million t lion for P-Net.	for Forward E This program	Based Convent n is in Budget	ional Strike, \$ Activity 3, A	4.0 million fo	r Minuteman I nology Develo	III, \$1.2 millio opment, since	on for Pacific	d
U) <u>B. Program Change Summary (\$ ir</u>	<u>Millions</u> )								••••	
D. Duraniana Durasi danti'a Durdant					<u>FY 20</u>		<u>FY 2007</u>		2008	<u>FY 2009</u>
<ul><li>J) Previous President's Budget</li><li>J) Current PBR/President's Budget</li></ul>					11.4 11.1		0.000 9.365		0.000 0.000	0.000 0.000
J) Total Adjustments					-0.2		9.505	,	0.000	0.000
J) Congressional Program Reductions					0.2					
Congressional Rescissions							-0.035			
Congressional Increases							9.400			
Reprogrammings										
SBIR/STTR Transfer					-0.2	89				
J) Significant Program Changes:										
In FY 1997, the Air Force eliminated C. Performance Metrics	this program.	However, Cor	igress has ado	led funds for C	Congressional-	directed effor	ts since FY 19	97.		
(U) Under Development.										
			R-1	Line Item No. 20 Page-1 of 3	6				Exhibit R-2 (Pl	E 0603311F
			11814	483 Classifie						

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	GET ACTIVITY dvanced Technology Developme	ent (ATD)				/BER AND TITL 11F Ballistic lology			ROJECT NUMBE 091 Missile E		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4091		11.146	9.365	0.000	0.000	0.000	0.000	0.000		0.000	47.294
	Quantity of RDT&E Articles	0	0	0	0	0	0	(	0		
	<b>A. Mission Description and Budget</b> This program develops, integrates, and safety instrumentation. In FY 2007, C Ballistic Missile Technology Program demonstrates technologies for existing	d demonstrates Congress addec , and \$2.4 mill	advanced gui 1 \$1.8 million lion for P-Net.	for Forward H This program	Based Convent m is in Budget	tional Strike, § Activity 3, A	64.0 million fo dvanced Tech	r Minutemar nology Deve	n III, \$1.2 milli clopment, since	on for Pacific	d
(U) (U) (U) (U)	<b>B. Accomplishments/Planned Progr</b> CONGRESSIONAL ADD: Ballistic In FY 2006: Conducted Congressional In FY 2007: Conduct Congressional In FY 2008: Not Applicable. In FY 2009: Not Applicable.	Missile Techn ally-directed e	ology/Minuter ffort for Ballis	tic Missile Te	echnology.		<u>FY 20</u> 7.9		7 <u>Y 2007</u> 3.985	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Pacific B In FY 2006: Conducted Congressional Program. In FY 2007: Conduct Congressionall In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ally-directed e	ffort for Pacifi	c Ballistic Mi			1.2	49	1.196	0.000	0.000
(U) (U) (U)	CONGRESSIONAL ADD: P-Net. In FY 2006: Conducted Congressional In FY 2007: Conduct Congressional In FY 2008: Not Applicable. In FY 2009: Not Applicable.	•					1.9	22	2.391	0.000	0.000
(U) (U)	CONGRESSIONAL ADD: Forward In FY 2006: Not Applicable. In FY 2007: Conduct Congressionall			l Based Conv	entional Strike	2.	0.0	00	1.793	0.000	0.000
Proj	ect 4091			R-1	Line Item No. 2 Page-2 of 3 484	6				Exhibit R-2a (P	E 0603311F)

				NOLASSI				DATE			
	Exhibit	: R-2a, RD1	C&E Projec	t Justifica	tion				February	2007	
BUDGET ACTIVITY 03 Advanced Technology Devel	opment (ATD	)							ECT NUMBER AND TITLE Missile Electronics		
<ul> <li>(U) <u>B. Accomplishments/Planned</u></li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	Program (\$ in	<u>Millions)</u>				<u>FY 20</u>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) Total Cost						11.1	46	9.365	0.000	0.000	
<ul> <li>(U) <u>C. Other Program Funding St</u></li> <li>(U) Related Activities:</li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	<u>Immary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	FY 2007 Estimate	FY 2008 Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> <u>Estimate</u>	FY 2011 Estimate	FY 2012 Estimate		<u>Cost to</u> Complete		
Project 4091				R-1 Line Item No Page-3 of 3 485 JNCLASSIF					Exhibit R-2a (F	PE 0603311F)	

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#### PE NUMBER: 0603400F PE TITLE: J-UCAS Joint Program Office

Evelopment (ATD)         Is)       FY 200         Actua         PE) Cost       80.         Vehicle       80.         weed Combat Air Systems         Actua         Iso       Iso         Iso       Iso         Iso       80.         Iso       Iso	6       FY 2007         Estimate         362       0.000         362       0.000         terms (J-UCAS) program in terminated and \$1000000000000000000000000000000000000	r Force/Navy ( r vehicles to p ed Persistent 1 operational sy requirements a FY07.	06034 FY 2009 Estimate 0.000 0.000 ansferred from eing realigned Capabilities D provide the cap Intelligence, S ystem developed for the United	to PE0604402 emonstration l pability for hig urveillance an nent decision	Joint Progr FY 2011 Estimate 0.000 0.000 Advanced Rese 2N in FY07-11 Program (CDF h-threat Suppl d Reconnaissa in the 2012 tir	FY 2012 Estimate 0.000 0.000 earch Projects P) to mature te ression of Ene ence (ISR) mis neframe.	chnologies to my Air Defen ssions. The pr	investigate the ses (SEAD), ogram will	
Actua         PE) Cost       80.         Vehicle       80.         weed Combat Air Systems       Solarian         Actua       80.         Med Combat Air Systems       Solarian         Actua       80.         Med Combat Air Systems       Solarian         Actua       80.         Med Combat Air Systems       Solarian         It Air Systems (J-U       Item Justems         Actual       Solarian       Solarian         It Air Systems (J-U       Item Justems       Item Justems         It Air Systems (Jourd Attains)       Item Justems       Item Justems         Item Systems       Item Justems       Item Justems       Item Justems         Item Systems       Item Systems       Item Justems       Item Syste	Estimate         362       0.000         362       0.000         tems (J-UCAS) protection (J-UCAS) protection (J-UCAS) is a joint Airmanned combat airmanned combat airck and carrier base (CAS) is a joint Airmanned combat airck and carrier base (J-UCAS) is a protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) protection (J-UCAS) p	Estimate 0.000 0.000 ogram was tra 1,830.5M is be r Force/Navy o r vehicles to p red Persistent 1 operational sy requirements r FY07.	Estimate 0.000 0.000 ansferred from eing realigned Capabilities D provide the cap Intelligence, S ystem develop for the United	Estimate 0.000 0.000 the Defense A to PE0604402 emonstration I pability for hig urveillance an nent decision	Estimate 0.000 0.000 Advanced Rese 2N in FY07-11 Program (CDF h-threat Suppl d Reconnaissa in the 2012 tir	Estimate 0.000 0.000 earch Projects P) to mature te ression of Ene nce (ISR) mis neframe.	Estimate 0.000 0.000 Agency (DAF chnologies to my Air Defen ssions. The pr	Complete 0.000 0.000 RPA) to be a jo investigate the ses (SEAD), ogram will	0.00 0.00
Actual         PE) Cost       80.         Vehicle       80.         weight       80.         and Combat Air Systems       80.         and Combat Air Systems       80.         and Air Systems is being       80.         and Budget Item Just       80.         at Air Systems (J-U       10.         rational value of un       10.         resistent Ground Attained       10.         as upport both Servit       10.         as terminating the J-       10.	3620.0003620.000terms (J-UCAS) propertiesterminated and \$ificationCAS) is a joint Airmanned combat airtack and carrier baseces and enable anof the future forceUCAS program ir	0.000 0.000 ogram was tra 1,830.5M is be r Force/Navy ( r vehicles to p red Persistent 1 operational sy requirements a FY07.	0.000 0.000 ansferred from eing realigned Capabilities D provide the cap Intelligence, S ystem develop for the United	0.000 0.000 the Defense A to PE0604402 emonstration I pability for hig urveillance an nent decision	0.000 0.000 Advanced Rese 2N in FY07-11 Program (CDF h-threat Suppl d Reconnaissa in the 2012 tir	0.000 0.000 earch Projects ?) to mature te ression of Ene nce (ISR) mis neframe.	0.000 0.000 Agency (DAF chnologies to my Air Defen ssions. The pr	0.000 0.000 RPA) to be a jo investigate the ses (SEAD), ogram will	0.00
Vehicle 80. Ned Combat Air Systems AS program is being <b>1 Budget Item Just</b> at Air Systems (J-U rational value of un resistent Ground Atta c support both Servi nse Review (QDR) as terminating the J-	362 0.000 tems (J-UCAS) pr terminated and \$ <b>ification</b> CAS) is a joint Air manned combat air ack and carrier bas ces and enable an of the future force UCAS program ir	0.000 ogram was tra 1,830.5M is be r Force/Navy ( r vehicles to p red Persistent 1 operational sy requirements requirements FY07.	0.000 ansferred from eing realigned Capabilities D provide the cap Intelligence, S ystem develop for the United	0.000 the Defense <i>A</i> to PE0604402 emonstration I pability for hig urveillance an nent decision	0.000 Advanced Rese 2N in FY07-11 Program (CDF h-threat Supp d Reconnaissa in the 2012 tir	0.000 earch Projects P) to mature te ression of Ene ence (ISR) mis neframe.	0.000 Agency (DAF chnologies to my Air Defen ssions. The pr	0.000 RPA) to be a jo investigate the ses (SEAD), rogram will	0.00
80. The Combat Air Systems AS program is being <b>I Budget Item Just</b> at Air Systems (J-U rational value of un resistent Ground Atta at support both Servi anse Review (QDR) as terminating the J-	tems (J-UCAS) pri terminated and \$ ification CAS) is a joint Air manned combat air ick and carrier bas ces and enable an of the future force UCAS program ir	rogram was tra 1,830.5M is be r Force/Navy ( r vehicles to p red Persistent 1 operational sy requirements requirements requirements	ansferred from eing realigned Capabilities D provide the cap Intelligence, S ystem develop for the United	the Defense A to PE0604402 emonstration I pability for hig urveillance an nent decision	Advanced Rese 2N in FY07-11 Program (CDF h-threat Supp d Reconnaissa in the 2012 tir	earch Projects ) to mature te ression of Ene nce (ISR) mis- neframe.	Agency (DAF chnologies to my Air Defen ssions. The pr	RPA) to be a jo investigate the ses (SEAD), rogram will	int Air
S program is being <b>I Budget Item Just</b> at Air Systems (J-U rational value of un rsistent Ground Atta c support both Servi mse Review (QDR) as terminating the J-	terminated and \$ <b>ification</b> CAS) is a joint Air manned combat air ick and carrier bas ces and enable an of the future force UCAS program ir	r Force/Navy ( r vehicles to p ed Persistent 1 operational sy requirements a FY07.	eing realigned Capabilities D provide the cap Intelligence, S ystem developi for the United	to PE0604402 emonstration l pability for hig urveillance an nent decision	2N in FY07-11 Program (CDF h-threat Supp d Reconnaissa in the 2012 tir	) to mature te ression of Ene nce (ISR) mis neframe.	chnologies to my Air Defen ssions. The pr	investigate the ses (SEAD), ogram will	
<b>I Budget Item Just</b> at Air Systems (J-U rational value of un rsistent Ground Atta : support both Servi nse Review (QDR) is terminating the J-	<b>ification</b> CAS) is a joint Air manned combat air tock and carrier bas ces and enable an of the future force UCAS program ir	r Force/Navy ( r vehicles to p ed Persistent 1 operational sy requirements requirements FY07.	Capabilities D provide the cap Intelligence, S ystem develop for the United	emonstration I bability for hig urveillance an nent decision	Program (CDF h-threat Supp d Reconnaissa in the 2012 tir	e) to mature te ression of Ene ance (ISR) mis meframe.	my Air Defen ssions. The pr	ses (SEAD), rogram will	
at Air Systems (J-U rational value of un rsistent Ground Atta support both Servi nse Review (QDR) as terminating the J-	CAS) is a joint Air manned combat air ack and carrier bas ces and enable an of the future force UCAS program ir	r vehicles to p eed Persistent 1 operational sy requirements FY07.	provide the cap Intelligence, S ystem develops for the United	bability for hig urveillance an ment decision	h-threat Suppl d Reconnaissa in the 2012 tir	ression of Ene ince (ISR) mis neframe.	my Air Defen ssions. The pr	ses (SEAD), rogram will	
stems technology el		or continued de	evelopment of	the Boeing an	nd Northrop G	rumman demo	onstrator progr	rams, and the	
nary (\$ in Millions)				FY 20	006	<u>FY 2007</u>	FY	2008	FY 2009
				76.6		0.000			
dget				80.3	364	0.000			
				3.6	573				
uctions									
				-1.9	151				
	g the J-UCAS pro	gram in FY07	and realignin	g \$1,830.5M i	n outyear fund	ling to PE0604	4402N.		
		R-1	Line Item No. 2 Page-1 of 3	7				Exhibit R-2 (PE	0603400F)
5	ections <u>:</u> DoD is terminatin	<u>u</u>	<u>:</u> DoD is terminating the J-UCAS program in FY07	2 DoD is terminating the J-UCAS program in FY07 and realigning R-1 Line Item No. 2 Page-1 of 3	5.6 -1.9 <u>5.7</u> DoD is terminating the J-UCAS program in FY07 and realigning \$1,830.5M i R-1 Line Item No. 27 Page-1 of 3	5.610 -1.937 DoD is terminating the J-UCAS program in FY07 and realigning \$1,830.5M in outyear fund R-1 Line Item No. 27 Page-1 of 3	5.610 -1.937 DoD is terminating the J-UCAS program in FY07 and realigning \$1,830.5M in outyear funding to PE0604 R-1 Line Item No. 27	5.610 -1.937 <u>2</u> DoD is terminating the J-UCAS program in FY07 and realigning \$1,830.5M in outyear funding to PE0604402N. R-1 Line Item No. 27 Page-1 of 3	5.610 -1.937 DoD is terminating the J-UCAS program in FY07 and realigning \$1,830.5M in outyear funding to PE0604402N. R-1 Line Item No. 27 Page-1 of 3 Exhibit R-2 (PE

		Exhibit R	2-2a, RDT&	E Project	Justificati	ion			DATE	February 2	2007
	ET ACTIVITY Ivanced Technology Develop	ment (ATD)	ITLE     PROJECT NUMBER AND TITLE       AS Joint Program     5067 Unmanned Combat Air       Tech Demo     Tech Demo								
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5067	Unmanned Combat Air Vehicle Tech Demo							0.000	0.000	0.000	0.000
	Quantity of RDT&E Articles	(	) 0	0	0 0	0	0	0	0		
Force/ (U) <u>/</u>	In FY06, the Joint Unmanned Co Navy program. The J-UCAS prog A. Mission Description and Budg	gram is being te get Item Justifi	rminated and \$ cation	1,830.5M is b	eing realigned	l to PE060440	2N in FY07-1	1.			
t I	The Joint Unmanned Combat Air S echnical feasibility and operationa Electronic Attack, Strike/Persisten lemonstrate capabilities that suppo	l value of unma t Ground Attack	nned combat a and carrier ba	ir vehicles to sed Persistent	provide the ca Intelligence, S	pability for hi Surveillance a	gh-threat Supp nd Reconnaiss	ression of Ene ance (ISR) mi	emy Air Defer	nses (SEAD),	e
	The 2005 Quadrennial Defense Re AW this recommendation, is term			-	s for the Unite	d States milita	ary recommend	led terminatio	n of the J-UCA	AS CDP. DoE	),
	This is a BA 03 program, Advance levelopment of common systems t	•••	-	or continued o	levelopment o	f the Boeing a	and Northrop G	rumman dem	onstrator prog	rams, and the	
(U)	<b>B. Accomplishments/Planned Pr</b> Continue development of J-UCAS demonstrator programs			ng and North	rop Grumman		<u>FY 20</u> 80.3	864	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) '	Total Cost						80.3	664	0.000	0.000	0.000
(U) <u>(</u>	C. Other Program Funding Sum	<u>mary (\$ in Mil</u>	lions)								
		<u>FY 2006</u> Actual	FY 2007 Estimate	FY 2008 Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete	<u>Total Cost</u>
. ,	Defense-Wide RDT&E PE0603400D8Z)	0.000	0.000	0.000	0.000	0.000	0.000	Littinate	Listinate	<u>complete</u>	
` '	Defense-Wide RDT&E PE0604400D8Z)	0.000	0.000	0.000	0.000	0.000	0.000				
(U) A	AF RDT&E (PE0604400F)	224.360	0.000	0.000	0.000	0.000	0.000				TBD
(U) N	NAVY RDT&E PE0604402N)	0.000	239.000	310.000	369.400	491.100	421.000			Continuing	TBD
Proje	ct 5067			R-	1 Line Item No. 2 Page-2 of 3 488	27				Exhibit R-2a (P	E 0603400F)

Exhibit R-2a, RDT&E Pr	DATE February 200	07	
BUDGET ACTIVITY 33 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603400F J-UCAS Joint Program Office	PROJECT NUMBER AND TITLE 5067 Unmanned Combat Air Tech Demo	
U) <u>D. Acquisition Strategy</u>			
Not applicable. The J-UCAS program is being terminated in FY07.			
Drainat 5067	R-1 Line Item No. 27		202400
Project 5067	Page-3 of 3 489	Exhibit R-2a (PE 06	003400

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#### PE NUMBER: 0603401F PE TITLE: Advanced Spacecraft Technology

	Exhibit R-2, RDT&E Budget Item Justification										DATE February 2007		
	T ACTIVITY vanced Technology Developme	-	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology										
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total		
	Cost (\$ III WIIIIolis)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete			
	Total Program Element (PE) Cost	86.327	101.115	78.704	85.838	99.947	100.531	94.156	95.707	Continuing	TBD		
2181	Spacecraft Payloads	30.434	30.389	22.801	27.423	29.265	29.277	23.072	23.611	Continuing	TBD		
3834	Integrated Space Technology Demonstrations	27.241	27.461	28.929	32.147	41.825	41.475	38.916	39.376	Continuing	TBD		
4400	Space Systems Protection	3.369	3.439	4.958	6.039	6.798	6.867	7.744	7.907	Continuing	TBD		
5021	Space Systems Survivability	4.428	4.806	4.866	5.292	5.489	5.571	5.684	5.808	Continuing	TBD		
5083	Ballistic Missiles Technology	3.488	3.901	5.847	6.197	6.472	6.625	6.611	6.607	Continuing	TBD		
682J	Spacecraft Vehicles	17.367	31.119	11.303	8.740	10.098	10.716	12.129	12.398	Continuing	TBD		

Note: Funds for the FY 2007 Congressionally-directed Massively Parallel Optical Interconnects in the amount of \$1.1 million were moved from this PE to PE 0603789F, C3I Advanced Development, Project 634216, for execution. Also, funds for the FY 2007 Congressionally-directed Advanced Satellite Thermal Control Program were moved from PE 0603211F, Aerospace Technology Development and Demonstration, Project 63486U, to this PE, for execution.

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

This program develops, integrates, and demonstrates space technologies in the areas of spacecraft payloads, spacecraft protection, spacecraft and launch vehicles, ballistic missiles, space systems survivability, and development of advanced laser communications technologies to support next generation satellite communication systems. The integrated space technologies are demonstrated by component or system level tests on the ground or in flight. Note: In FY 2007, Congress added \$2.9 million for Precision Integrated Navigation and Position-Intelligent Networking Technology; \$1.6 million for Space Situational Awareness/Star Tracking System; \$1.0 million for Information Sciences Institute Microsatellite Serial Manufacturing Demonstration Program; \$1.1 million for Small Low-Cost Reconnaissance Spacecraft; \$1.0 million for Photovoltaic Module Development for Lighter Than Air Vehicles; \$1.0 million for Radically Segmented Launch Vehicle (RSLV) Risk Reduction; \$1.0 million for Micromachined Switches for Next-Generation Modular Satellites; \$1.0 million for Large Automated Production of Expendable Launch Structures (LAPELS); \$2.0 million for Microsatellite Serial Manufacturing; \$2.8 million for Systemic Hierarchical Approach to Radiation Hardened Electronics; \$1.0 million for COTS Technology for Situational Awareness; \$1.0 million for Integrated Passive Microelectronic Components; \$1.3 million for Integrated Spacecraft Engineering Tool; \$1.4 million for Intelligent Free Space Optical Satellite Communications Node; \$1.1 million for Massively Parallel Optical Interconnects; and \$10.4 million for Thin Film Amorphous Solar Arrays. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing space system upgrades and/or new space system developments that have military utility and address warfighter needs.

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Page-1 of 28	Exhibit R-2 (PE 0603401F)
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Exhibit R-2, RDT&E Budç	DATE Februa	ry 2007		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)				
(U) <u>B. Program Change Summary (\$ in Millions)</u>				
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	85.564	68.026	79.897	85.435
(U) Current PBR/President's Budget	86.327	101.115	78.704	85.838
(U) Total Adjustments	0.763			
(U) Congressional Program Reductions		-0.028		
Congressional Rescissions	-0.002	-0.383		
Congressional Increases		33.200		
Reprogrammings	2.280	0.300		
SBIR/STTR Transfer	-1.515			
(U) <u>Significant Program Changes:</u>				
	R-1 Line Item No. 28 Page-2 of 28		Exhibit R-	2 (PE 0603401F

	Exhibit R-2a, RDT&E Project Justification February 2007											2007
BUDGET ACTIVITY       PE NUMBER AND TITLE       PROJECT NUMBER AND TITLE         03 Advanced Technology Development (ATD)       0603401F Advanced Spacecraft       2181 Spacecraft Payloads         Technology       Technology												
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012		2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate		mate	Complete	
2181	Spacecraft Payloads Quantity of RDT&E Articles	30.434	<u>30.389</u> 0	22.801	27.423	29.265 0	29.277 0	23.0	72 0	23.611 0	Continuing	TBD
(U)	A. Mission Description and Budget			0	0	0	0		0	0		
	This project funds the development, d advanced satellite surveillance operati systems. Improved space-qualifiable near-term, this project's work concent systems. For mid-term applications, t technologies with commercially-deriv of Defense satellites. In the long-term constellations of intelligent satellites of	ons, and devel electronics and rates on conve he Improved S red, open syste h, this project a	lopment of adv d software for rting (i.e., radi Space Compute m architecture urea focuses or	vanced laser c data and signa ation-hardeni er Program wi s to develop a n developing l	communication al processing v ing) commerci ill merge adva- and demonstra low-cost, easily	is technologies will be more ir al data and sig nced, radiation te robust, on-b y modifiable s	s to support ne nterchangeable nal processor n-hardened sp poard processi oftware and h	ext generat e, interoper technologi ace process ng capabili	ion satelli able, and es for use sor, memo ities for 2	te comi standar in Air ory, and 1st cent	nunications rdized. In the Force space interconnect ury Departme	
(U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop spacecr processors and ultra-high density stra advanced packaging technology, and applications.	aft microelectr tegically harde	conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic devices, conic	, space-qualif	fiable, high dei	nsity	<u>FY 20</u> 10.1		<u>FY 2007</u> 11.068		<u>FY 2008</u> 11.662	<u>FY 2009</u> 13.417
(U)	In FY 2006: Developed and validated million instructions per second. Prov commercial design tools. Fabricated initial hardened structured application performance on low cost devices. De miniaturized military Global Position	ided the set of a 16 megabyte a specific integ ssigned and fat	design tools f chalcogenide grated circuit ( pricated the ini	or integrating -based nonvo ASIC) to impl tial test vehic	hardening by latile memory lement increas le to demonstr	design into Designed ed ASIC rate the						
	In FY 2007: Complete engineering n general-purpose processor. Fabricate (ADC) for use in space and design a v hardening. Fabricate the miniaturized platforms. Fabricate the building bloc field programmable gate array.	a high perform very low-powe d military GPS cks for a very	nance design l r ADC using a receiver for u high performa	hardened anal advanced desi se on terrestri nce ten millio	og-to-digital c ign cells and de ial, aero, and s on-gate design	onverter esign pace hardened						
	In FY 2008: Initiate capabilities to the sequence to form a "push-button toold											
Proje	ect 2181				Line Item No. 28 Page-3 of 28 493	8					Exhibit R-2a (P	E 0603401F)

Exhibit R-2a, RDT&E Project Justification DATE February 2007									
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advance Technology			CT NUMBER AND TITLE Spacecraft Payloads				
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> interface modules allocating standardized data messages protocols from senso of sensors and actuators.	ors for ease device control	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U)	In FY 2009: Complete capabilities to the current Satellite Design Automation logical sequence to form a "push-button toolflow" satellite builder. Demonstr sensor interface modules allocating standardized data messages protocols from control of sensors and actuators.	rate radiation-harden space							
(U) (U)	MAJOR THRUST: Develop intelligent satellite system technologies for resp operations and for satellite control, precision navigation, formation flying, and technologies for spacecraft constellations.	-	3.219	2.523	2.699	2.775			
(U)	In FY 2006: Validated command and control capabilities and guidance, navig algorithms for proximity operations with flight experiment data. Refined com and navigational capabilities for space superiority to apply to space situational offensive/defensive operations. Completed command and telemetry simulation ops center testing. Completed integration of hardware-in-the-loop engineering testbed, interface with spacecraft command and telemetry simulations, and con testing. Built unique distributed aperture sensor simulation modules for engine mission/engagement and campaign level analysis tool.	nmand, control, guidance, al awareness and on development for mission ag development unit into onducted mission ops center							
(U)	In FY 2007: Continue to refine command, control, guidance, and navigationa counterspace to apply to space situational awareness and offensive/defensive integrate autonomous flight software technologies with command, control, guidechnologies to support responsive space systems. Extend hardware-in-the-loc command and telemetry simulations, and mission ops center to development and tactical space systems. Integrate modules and complete distributed apertue engineering level, mission/engagement and campaign level analyses.	operations. Begin to hidance, and navigation oop testbed, spacecraft and testing of responsive							
(U) (U)	In FY 2008: Further refine command, control, guidance, and navigational cap superiority. Continue to integrate autonomous flight software technologies w guidance, and navigation technologies. Continue to extend hardware-in-the-l command and telemetry simulations, and mission ops centers. Begin to mode communications systems, conduct engineering trades, and perform military u In FY 2009: Complete command, control, guidance, and navigational capabi	vith command, control, oop testbed, spacecraft el command, control, and tility analysis.							
. ,		-1 Line Item No. 28 Page-4 of 28			Exhibit R-2a (	PF 0603401F)			

	Exhibit R-2a, RDT&E Project Justification February 2007									
	T ACTIVITY vanced Technology Development (ATD)		PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology			S				
	8. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>				
na te	Complete integration of autonomous flight software technologies with commu- avigation technologies. Complete extension of hardware-in-the-loop testbec elemetry simulations, and mission ops centers. Continue to model command ommunications systems, conduct engineering trades, and perform military up	l, spacecraft command and , control, and								
(U)										
m	AAJOR THRUST: Develop modeling, simulation, and analysis tools and da nethodologies for space-based surveillance systems, space capability protectic ccess/mobility technologies, and flight experiments.	-	0.625	1.227	0.718	0.738				
(U) In ta te er	n FY 2006: Expanded development of models of surveillance systems for m actical surveillance and electro-optical technologies. Developed model response echnologies. Refined development of physics-to-engineering-to-engagement ngineering, tech trades, mission planning and operations, and utility analysis	onsive and reconfigurable t level models for systems								
(U) In ta re er	actical and responsive satellites. n FY 2007: Complete development of models of surveillance systems for m actical surveillance and electro-optical technologies. Continue to develop me econfigurable technologies. Apply physics-to-engineering-to-engagement le ngineering, tech trades, mission planning and operations, and utility analysis actical and responsive satellites.	odels of responsive and vel models for systems								
av re le	n FY 2008: Begin development of space-based communications models for wareness, communications on the move, and data exfiltration. Complete dev esponsive or reconfigurable technologies. Continue to apply physics-to-engi evel models for systems engineering, tech trades, mission planning and opera o flight experiments in tactical and responsive satellites.	velopment of models of neering-to-engagement								
av pł	n FY 2009: Continue to develop space-based communications models for bl wareness, communications on the move, and data exfiltration. Apply addition hysics-to-engineering-to-engagement level models for systems engineering, lanning and operations, and utility analysis to flight experiments in tactical a	onal tech trades, mission								
(U)		Ĩ								
(U) M ar	AAJOR THRUST: Develop advanced space infrared technology and harden rrays to enable acquisition, tracking, and discrimination of hot targets, as we uch as decoys, satellites, and midcourse warheads. Note: In FY 2008, incre-	ll as "cold body" targets	2.557	2.657	6.458	9.397				
Project		-1 Line Item No. 28 Page-5 of 28			Exhibit R-2a (I	PE 0603401F)				

Exhibit R-2a, RDT&E Project Justification February 2007								
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Technology	0603401F Advanced Spacecraft			6		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> increased emphasis on hardened focal planes for the next generation satellite		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2006: Assessed large format Read Out Integrated Circuits (ROICs), of hardened-by-design (RHBD), and fabricated on existing foundries. Investig focal plane array performance enhancements needed for emerging detector a	gated the readout and greater						
(U)	In FY 2007: Initiate studies for detectors and readouts needed for laser-base investigation into readouts fabricated on existing foundries and radiation has							
(U)	In FY 2008: Continue studies for detectors and readouts needed for exquisit size/speed of RHBD ROICs. Fold radiation hardness improvement of visible into full focal plane array.	te imaging. Increase						
(U)	In FY 2009: Begin full focal plane array for exquisite imaging. Develop vir transition.	sible sensor for potential						
(U)								
(U)	MAJOR THRUST: Develop technologies for multi-access laser communication reduced weight, power, and cost for transformational communications.	ations space terminals with	2.102	1.343	1.064	0.887		
(U)	In FY 2006: Developed components toward space-qualification and brassbo multi-access laser communications terminal brassboard. Tested components environment.	•						
(U)	In FY 2007: Finalize brassboard integration.							
	In FY 2008: Begin multi-access laser communications terminal form-fit-fur Continue environmental testing of multi-access laser communications termin subsystems in relevant environment.							
(U)	In FY 2009: Complete multi-access laser communications terminal form-fit Complete testing of multi-access laser communications terminal component environment. Initiate multi-access laser communications terminal system le environment.	s and subsystems in relevant						
(U)								
(U)	MAJOR THRUST: Develop spectral/polarimetric sensing and data exploitat military imaging and remote sensing applications. Note: In FY 2006, advan		1.847	0.214	0.200	0.209		
	from PE 0602601F, Space Technology.	1 11 1 4 4 4 4 6						
(U)	In FY 2006: Completed polarimetric focal plane array (FPA) test article and Integrated FPA into laboratory camera and collect high quality data in the la	-						
Pro	ject 2181	R-1 Line Item No. 28 Page-6 of 28			Exhibit R-2a (F	PE 0603401E)		

	Exhibit R-2a, RDT&E Proje	ct Justification		DATE	February	2007
BUDGET ACTIVITY 03 Advanced T	echnology Development (ATD)	PE NUMBER AND TITL 0603401F Advance Technology		ABER AND TITLE	6	
	ishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
materials.	Conduct field collection with polarimetric focal plane camera.	Demonstrate feasibility of				
	sign for transition to acquisition system.	. Demonstrate reasionity of				
	Collect laboratory data of satellites using spectral/polarimetric	sensing and demonstrate				
	of techniques for space situational awareness.	sensing and demonstrate				
11 *	Compare measurements of satellites to predictive models and	determine the feasibility of				
	l exploitation for space situational awareness.					
(U)	· · · F · · · · · · · · · · · · · · · ·					
	SIONAL ADD: Alternating Current (AC) Coupled Interconnec	et.	1.452	0.000	0.000	0.000
(U) In FY 2006:	Conducted Congressionally-directed effort for AC Coupled In	iterconnect.				
(U) In FY 2007:	Not Applicable.					
(U) In FY 2008:	Not Applicable.					
(U) In FY 2009:	Not Applicable.					
(U)						
· · /	SIONAL ADD: Magnetoresistive Random Access Memory (M		0.968	0.000	0.000	0.000
	tions Materials/Magnetic Random-Access Memory Communication					
	Conducted Congressionally-directed effort for Magnetic Rand	lom-Access Memory				
	tions Materials.					
	Not Applicable.					
	Not Applicable.					
	Not Applicable.					
(U)			1.1.0	0.000	0.000	0.000
· /	SIONAL ADD: Radiation Hardened Microelectronics.		1.162	0.000	0.000	0.000
	Conducted Congressionally-directed effort for Radiation Hard	lened Microelectronics.				
	Not Applicable.					
	Not Applicable. Not Applicable.					
(U) III 1 2009.	Not Applicable.					
	SIONAL ADD: Systemic Hierarchical Approach to Radiation I	Hardened Electronics	2.324	2.790	0.000	0.000
	Conducted Congressionally-directed effort for System Approa		2.327	2.170	0.000	0.000
Electronics.						
		R-1 Line Item No. 28				
Project 2181		Page-7 of 28 497			Exhibit R-2a (I	PE 0603401F)

ct Justification			February	2007
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
nical Approach to Radiation				
	• • • • •	1.005	0.000	0.000
	2.906	1.395	0.000	0.000
Space Optical Satellite				
one Ortical Catallita				
bace Optical Satellite				
talligant Natworking	1 162	2 880	0.000	0.000
nemgent Networking	1.102	2.009	0.000	0.000
ated Navigation and				
ated Mavigation and				
ed Navigation and				
eness.	0.000	0.996	0.000	0.000
y for Situational Space				
S.	0.000	0.996	0.000	0.000
R-1 Line Item No. 28				
Page-8 of 28			Exhibit R-2a (I	PE 0603401F)
	0603401F Advance         Technology         anical Approach to Radiation         anunications Node.         Space Optical Satellite         bace Optical Satellite         ace Optical Satellite         atelligent Networking         ated Navigation and         ed Navigation and         eness.         y for Situational Space         s.         R-1 Line Item No. 28	FY 2006         nical Approach to Radiation         nunications Node.         Space Optical Satellite         bace Optical Satellite         natelligent Networking         nated Navigation and         ed Navigation and         eness.       0.000         y for Situational Space         s.       0.000         R-1 Line Item No. 28         Page-8 of 28	O603401F Advanced Spacecraft Technology       2181 Space         FY 2006       FY 2007         aical Approach to Radiation       FY 2006         unications Node.       2.906         Space Optical Satellite       1.395         space Optical Satellite       1.162         ated Navigation and       0.000       0.996         eness.       0.000       0.996         s,       0.000       0.996         R-1 Line Item No. 28       Page-8 of 28	0603401F Advanced Spacecraft Technology       2181 Spacecraft Payload:         hical Approach to Radiation       FY 2006       FY 2007       FY 2008         nunications Node.       2.906       1.395       0.000         Space Optical Satellite       2.906       1.395       0.000         space Optical Satellite       1.162       2.889       0.000         rated Navigation and       0.000       0.996       0.000         eness.       0.000       0.996       0.000         y for Situational Space       0.000       0.996       0.000         s.       0.000       0.996       0.000         state Image: Space of 28       Exhibit R-2a (Image: Space of 28       Exhibit R-2a (Image: Space of 28

		Exhibit	: R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007	
	GET ACTIVITY Advanced Technology Develo	opment (ATD	)		0603	UMBER AND TIT 3401F Advan hnology			DJECT NUMBER AND TITLE 31 Spacecraft Payloads			
(U) (U)	<b>B. Accomplishments/Planned</b> In FY 2007: Conduct Congressi			grated Passive	Microelectron	ic	<u>FY 20</u>	<u>)06 I</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Inte previously executed in Project 6 In FY 2006: Not Applicable. In FY 2007: Conduct Congressi	33834.					0.0	000	1.295	0.000	0.000	
U) U) U) U) U) U) U) U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable. CONGRESSIONAL ADD: Mid In FY 2006: Not Applicable. In FY 2007: Conduct Congressi Modular Satellites. In FY 2008: Not Applicable.						0.0	000	0.996	0.000	0.000	
(U) (U)	In FY 2009: Not Applicable. Total Cost						30.4	-34	30.389	22.801	27.423	
(U)	C. Other Program Funding Sur	-										
	Related Activities:	<u>FY 2006</u> <u>Actual</u>	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost	
(U) (U)	PE 0303601F, MILSTAR Satellite Communications System. PE 0305160F, Defense Meteorological Satellite Program (DMSP). PE 0602601F, Spacecraft											
0)	Technology.					20						
	ject 2181			ŀ	R-1 Line Item No	. 28						

Exhibit R-2a, RDT&E Pr		DATE February 2007		
JDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 2181 Spacecraft Payloads		
<b>D</b> <u><b>C. Other Program Funding Summary (\$ in Millions)</b></u>				
J) PE 0603311F, Ballistic				
Missile Technology.				
J) PE 0603215C, Limited				
Defense System.				
J) PE 0603218C, Research and				
Support.				
J) PE 0603226E, Experimental				
Evaluation of Major				
Innovative Technologies.				
J) PE 0604609F, Reliability and				
Maintainability Technology				
Insertion Program (RAMTIP).				
J) This project has been				
coordinated through the				
Reliance 21 process to harmonize efforts and				
eliminate duplication.				
-				
J) <u>D. Acquisition Strategy</u>				
Not Applicable.				
	R-1 Line Item No. 28			
Project 2181	Page-10 of 28		Exhibit R-2a (PE 0603401	

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY dvanced Technology Developm	ent (ATD)				MBER AND TITL 01F Advanc lology		aft 38	OJECT NUMBE	d Space Teo	chnology
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3834	Integrated Space Technology Demonstrations	27.241	27.461	28.929	32.147	41.825	41.475	38.916			TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	A. Mission Description and Budget This project is a series of advanced te Laboratory, other Government labora validate the technologies in an relevan	chnology demo tories, and indu	onstrations des astry. These to	-				-			
(U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop microsa microsatellite demonstrations buildin organizations. Applications include s concepts.	atellite (10-100 g on previous v	Kg) technolog work and leve	raging investr	nents by other		<u>FY 20</u> 23.9		<u>Y 2007</u> 26.465	<u>FY 2008</u> 28.929	<u>FY 2009</u> 32.147
(U)	In FY 2006: Completed autonomous	-	-		series of satell	ite designs.					
(U)	Procured initial bus and payload hard In FY 2007: Complete payload and b payload and bus. Complete system be functional and environmental tests of Integrate ground control system and s operations for missions operations tra	bus fabrication. evel integration integrated syst satellite softwar ining.	Perform fund of payload an tem. Begin in re simulations	ctional and en nd microsatell tegration with . Perform sin	lite and completed and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete and complete	ete le. n					
	In FY 2008: Complete system level is and environmental tests of integrated control system and satellite software operations training.	system. Begir simulations. P	n integration werform simula	vith launch vei ted mission o	hicle. Integrations for r	te ground nissions					
	In FY 2009: Complete autonomous f in the series of satellite design(s). Ini	-			-	plete next					
(U)	CONGRESSIONAL ADD: Integrate Add has been moved to Project 63213 In FY 2006: Conducted Congression	81, for execution	on.				0.9	69	0.000	0.000	0.000
	(ISET). oct 3834				Line Item No. 2 Page-11 of 28 501	8				Exhibit R-2a (P	E 0603401F)

Exhibit R-2a, RDT&E Project Justification         Drift         February 2           BUDGET ACTIVITY         PE NUMBER AND TITLE         PROJECT NUMBER AND TITLE         PROJECT NUMBER AND TITLE         PROJECT NUMBER AND TITLE         B341 Integrated Space Tec         Demonstrations           (U)         B.Accomplishments/Planned Program (\$ in Millions)         FY 2006         FY 2007         FY 2008         Demonstrations           (U)         In FY 2007: Not Applicable.         FY 2006         FY 2007         FY 2008         EY 2007         FY 2008         U           (U)         In FY 2008: Not Applicable.         U         U         U         U         CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process. Note: In FY 2007, this Add         1.355         0.000         0.000           (U)         U         In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.         U         U         Not Applicable.         U         U         U         Not Applicable.	
(U)       In FY 2007: Not Applicable.         (U)       In FY 2008: Not Applicable.         (U)       In FY 2009: Not Applicable.         (U)       In FY 2009: Not Applicable.         (U)       CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process. Note: In FY 2007, this Add       1.355       0.000       0.000         has been moved to Project 63682J, for execution.       In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.       Process.       In FY 2007: Not Applicable.         (U)       In FY 2009: Not Applicable.       In FY 2009: Not Applicable.       In FY 2009: Not Applicable.         (U)       In FY 2009: Not Applicable.       0.969       0.996       0.000         (U)       In FY 2009: Not Applicable.       0.969       0.996       0.000         (U)       CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.       0.969       0.996       0.000         (U)       In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.       0.969       0.996       0.000         (U)       In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV)       Risk Reduction.       0.969       0.996       0.000         (U)       In FY 2008: Not Applicable.       0.1 FY 2009: Not Applicable.	<u>FY 2009</u>
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process. Note: In FY 2007, this Add 1.355 0.000 0.000 has been moved to Project 63682J, for execution.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C.Other Program Funding Summary (\$ in Millions)</li> </ul>	
<ul> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process. Note: In FY 2007, this Add 1.355 0.000 0.000 has been moved to Project 63682J, for execution.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
(U)       CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process. Note: In FY 2007, this Add       1.355       0.000       0.000         has been moved to Project 63682J, for execution.       (U)       In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.       1.355       0.000       0.000         (U)       In FY 2007: Not Applicable.       (U)       In FY 2008: Not Applicable.       (U)       1.100000000000000000000000000000000000	
<ul> <li>(U) CONGRESSIONAL ADD: Microsatellite Serial Manufacturing Process. Note: In FY 2007, this Add 1.355 0.000 0.000 has been moved to Project 63682J, for execution.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
<ul> <li>has been moved to Project 63682J, for execution.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) U</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
<ul> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing Process.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) 0. CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) 0. CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) 10. FY 2006: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	0.000
Process. (U) In FY 2007: Not Applicable. (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. (U) (U) (U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction. (U) (U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction. (U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction. (U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction. (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. (U) In FY 2009: Not Applicable. (U) Total Cost (C) Cotter Program Funding Summary (\$ in Millions) (C) EX 2006 EX 2007 EX 2009 EX 2010 EX 2011 EX 2012 EX 2013 Cost to	
<ul> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
<ul> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> <li>(U) Total Cost</li> <li>(U) COMPARE FY 2006</li> <li>(U) EX 2006</li> <li>(U) EX 2007</li> <li>(U) EX 2007</li> <li>(U) EX 2007</li> <li>(U) EX 2008</li> <li>(U) EX 2012</li> <li>(U) EX 2012</li> <li>(U) EX 2013</li> <li>(U) Cost to EX 2007</li> <li>(U) EX 2008</li> <li>(U) EX 2012</li> <li>(U) EX 2013</li> <li>(U) EX 2014</li> <li>(U) EX 2013</li> <li>(U) EX 2014</li> <li>(U) EX 2014</li> <li>(U) EX 2015</li> <li>(U) EX 201</li></ul>	
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> <li>27.241</li> <li>27.461</li> <li>28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
<ul> <li>(U) CONGRESSIONAL ADD: Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> <li>27.241</li> <li>27.461</li> <li>28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
<ul> <li>(U) In FY 2006: Conducted Congressionally-directed effort for Radially Segmented Launch Vehicle Risk Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	0.000
<ul> <li>Reduction.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	0.000
<ul> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Radially Segmented Launch Vehicle (RSLV) Risk Reduction.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 27.241 27.461 28.929</li> <li>(U) C. Other Program Funding Summary (\$ in Millions)</li> </ul>	
Risk Reduction.         (U) In FY 2008: Not Applicable.         (U) In FY 2009: Not Applicable.         (U) Total Cost         27.241       27.461       28.929         (U) C. Other Program Funding Summary (\$ in Millions)         EX 2006       EX 2007       EX 2008       EX 2010       EX 2012       EX 2013       Cost to	
(U) In FY 2009: Not Applicable.         (U) Total Cost         (U) C. Other Program Funding Summary (\$ in Millions)         EX 2006       EX 2007         EX 2006       EX 2007         EX 2006       EX 2007	
(U) In FY 2009: Not Applicable.         (U) Total Cost         (U) C. Other Program Funding Summary (\$ in Millions)         EX 2006       EX 2007         EX 2006       EX 2007         EX 2006       EX 2007	
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> EV 2006 EV 2007 EV 2008 EV 2000 EV 2010 EV 2011 EV 2012 EV 2013 Cost to	
EV 2006 EV 2007 EV 2009 EV 2000 EV 2010 EV 2011 EV 2012 EV 2012 Cost to	32.147
EV 2006 EV 2007 EV 2009 EV 2000 EV 2010 EV 2011 EV 2012 EV 2012 Cost to	
<u>Actual Estimate Estimate Estimate Estimate Estimate Estimate</u>	<u>Fotal Cost</u>
(U) Related Activities:	
(U) PE 0602601F, Spacecraft	
Technology.	
(U) PE 0603605F, Advanced	
Weapons Technology.	
(U) This project has been	
coordinated through the	
Reliance 21 process to	
R-1 Line Item No. 28	06034045
Project 3834         Page-12 of 28         Exhibit R-2a (PE           502         502	0003401F)

Exhibit R-2a, RDT&E Pr	roject Justification		DATE February 2007	
JDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 3834 Integrated Space Tech Demonstrations		
J) <u>C. Other Program Funding Summary (\$ in Millions)</u> harmonize efforts and eliminate duplication.				
J) <u>D. Acquisition Strategy</u>				
Not Applicable.				
Project 3834	R-1 Line Item No. 28 Page-13 of 28		Exhibit R-2a (PE 060340	

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY dvanced Technology Developme	ent (ATD)				IBER AND TITL 01F Advanc ology			ROJECT NUMB	ER AND TITLE	ection
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4400	1 2	3.369	3.439	4.958	6.039	6.798	6.867	7.74			TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0 0	)	
	A. Mission Description and Budget This project develops and demonstrate warfighting environments. The project (RF) and laser threats. This project al palanced satellite protection strategies	es tools, instru et performs ass so develops te	ments, and mi sessments of c chnologies tha	ritical compon at mitigate ide	nents and subs ntified vulnera	ystems, and evabilities. Tech	valuates susce nologies are c	ptibility and	vulnerability	to radio freque	ncy
(U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Use multi-threat communication, and other responses t energy threats.	assessment to	ols to assess sp		-	lirected	<u>FY 20</u> 0.7		<u>FY 2007</u> 0.825	<u>FY 2008</u> 1.191	<u>FY 2009</u> 1.450
(U)	In FY 2006: Performed predicative a the satellite constellation analysis too constellation analysis tool. In FY 2007: Verify mitigation model	l. Modeled mi	tigation techn	iques and inco	orporated into	-					
(U)	effectiveness. In FY 2008: Conduct laboratory testi multi-threat assessment tool.	ng of candidat	e RF and Lase	er countermea	sures and valio	date					
	In FY 2009: Conduct demonstrations transfer opportunities and report findi	-		itation analysi	is. Identify teo	chnology					
	MAJOR THRUST: Develop passive future threats to satellites.	satellite count	ermeasures an	d mitigation t	echniques for	current and	1.7	29	1.823	2.627	3.200
	In FY 2006: Selected the most promi and integration. Identified potential of environmental phenomenon associate navigation, etc.).	of multiple-use	technologies	to detect threa	ats and measur	re					
(U)	In FY 2007: Conduct defensive techn technology transfer opportunities. In FY 2008: Select the most promisin										
	ect 4400			R-1	Line Item No. 2 Page-14 of 28 504					Exhibit R-2a (F	PE 0603401F)

		Exhibi	t R-2a, RD	F&E Projec	t Justifica	tion			DATE	February	2007
	GET ACTIVITY Advanced Technology Deve		0603	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology				PROJECT NUMBER AND TITLE 4400 Space Systems Protection			
(U)	<b>B.</b> Accomplishments/Planne	d Program (\$ in	<u>Millions)</u>				<u>FY 2</u>	<u>006 I</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
	Conduct demonstrations of sy	-	-								
(U)	In FY 2009: Conduct mitigati	ion technology sp	ace demonstra	tion and post f	ight analysis.						
(U)											
(U)	MAJOR THRUST: Develop		-		-	. 1 1	0.3	857	0.791	1.140	1.389
(U)	In FY 2006: Demonstrated vi test of optical sensor subsystem										
	protection techniques and eval										
	subsystems. Coordinated space			•		ensor					
(U)	In FY 2007: Coordinate space			-		y transfer					
	opportunities and report findir		-			-					
(U)	In FY 2008: Develop selected	-	-	-		-					
	prospective protection technol	logy. Qualify tec	hnology for ap	plication on sp	ace experiment	t for orbital					
T D	demonstration.	1.6. 18 ( 1.	.1	1							
$(\mathbf{U})$	In FY 2009: Nominate "space integration.	e qualified techn	ology and prov	ide test unit to	experimental	satellite for					
(U)	Total Cost						3.	369	3.439	4.958	6.039
(U)	C. Other Program Funding S	Summary (\$ in N	( <b>Iillions</b> )								
		<u>FY 2006</u>	FY 2007	<u>FY 2008</u>	FY 2009	FY 2010	<u>FY 2011</u>	<u>FY 2012</u>	FY 2013	Cost to	Total Cost
		Actual	Estimate	Estimate	Estimate	<b>Estimate</b>	Estimate	Estimate	Estimate		<u>Total Cost</u>
` ´	Related Activities:										
. ,	PE 0602102F, Materials.										
(U)	PE 0602601F, Spacecraft										
<b>T</b> D	Technology. PE 0603605F, Advanced										
(0)	Weapons Technology.										
U)	This project has been										
- /	coordinated through the										
	Reliance 21 process to										
	harmonize efforts and										
	eliminate duplication.										
				1	R-1 Line Item No	28					
	ject 4400					. 20					

Exhibit R-2a, RDT&E	DATE February 2007	
JDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 4400 Space Systems Protection
J) <b><u>D. Acquisition Strategy</u></b> Not Applicable.		
Not Applicable.		
Project 4400	R-1 Line Item No. 28 Page-16 of 28	Exhibit R-2a (PE 060340

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	GET ACTIVITY Advanced Technology Developme	ent (ATD)					E ed Spacecra		ROJECT NUMBE		ivability
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
502	1 Space Systems Survivability Quantity of RDT&E Articles	4.428	4.806	4.866	5.292	5.489 0	5.571	<u>5.684</u> 0		Continuing	TBD
				0	0	0	0	0	0		
(U)	<b>A. Mission Description and Budget</b> This project develops and demonstrate that must continue operation despite n interactions including electrical charge	es technologies atural space h	s to improve sp azards. It deve	lops and dem	onstrates cost-	effective solu	tions to mitiga	te hazardous	space environ	· ·	ms
(U)	<b>B. Accomplishments/Planned Prog</b>	ram (\$ in Mill	<u>ions)</u>				<u>FY 20</u>	<u>06 F</u>	Y 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	MAJOR THRUST: Develop sensors degrade the operation of satellite, con- integration, launch, validation, and op- ionospheric hazard specification and i In FY 2006: Completed concept desi imager for next-generation solar hazar nano-technology sensors for energetic characterization. In FY 2007: Identify space test oppo- heliospheric imager for solar hazard of miniaturized space weather sensors an In FY 2008: Continue construction o hazard detection. Continue developm Initiate program to test and evaluate of Force and national observatory assets	nmunication, n peration of inst forecasting. gn for joint-ag rd detection sy c particle, neut rtunity and beg letection. Con nd begin devel f joint agency nent of miniatu empirical flare	avigation, and rumentation to ency space-ba /stem. Design ral density, low gin construction nplete concept opment of eng coronagraph a urized space wo	l surveillance o provide imp ased coronagra ed concept m w-energy plas on of joint age design of ney gineering mod and heliospher eather sensor	systems. Supproved space ra aph and heliospicro- and sma space weater ency coronagra st-generation lels. ric imager for se	port diation and pheric ther ph and solar odels.	3.0	43	3.671	3.683	4.066
(U) (U) (U)	In FY 2009: Continue construction o hazard detection. Complete developm Identify space test opportunity for mi evaluate empirical flare prediction mo observatory assets. MAJOR THRUST: Conduct collabor	f joint agency nent of miniatu niaturized sola odels based on	urized space w r hazard senso synoptic data	veather sensor ors. Continue from Air For	engineering n program to tes ce and nationa	nodels. st and l	0.3	75	0.370	0.382	0.389
	software tools to improve the surviva	bility of space	craft power, co		ns, navigation, Line Item No. 28						
Pro	ject 5021				Line item No. 20 Page-17 of 28	0				Exhibit R-2a (P	E 0603401F)
					507						

Exhibit R-2a, RD	Exhibit R-2a, RDT&E Project Justification										
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Technology	Spacecraft		IBER AND TITLE Systems Sur							
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>						
<ul> <li>surveillance systems.</li> <li>(U) In FY 2006: Developed space plasma control experiment plattether propulsion and particle remediation concepts. Integratter radiation belt forecast models into spacecraft environment effective demonstrate radiation belt remediation technologies using electronic space plasma control experiment.</li> </ul>	d dynamic space particle climatology and ect tool suite. Fabricated payload to										
<ul> <li>(U) In FY 2007: Construct space plasma control experiment pay collaboration for spaceflight. Continue expansion of spacecr dynamic space particle climatologies and forecast models. C and begin calibration and integration onto Air Force test sate</li> </ul>	bad and establish joint-agency ft environment effect tool suite to include omplete radiation belt remediation payload										
(U) In FY 2008: Complete space plasma control experiment payl onto Air Force test satellite. Complete spacecraft environme particle climatologies and forecast models. Release tool suite belt remediation payload calibration and complete integration	ad and begin calibration and integration t effect tool suite to include dynamic space to DoD community. Complete radiation										
(U) In FY 2009: Launch space plasma control experiment paylor Begin on-orbit checkout and in-flight calibration. Begin dever radiation belt model. Launch radiation belt remediation payl Begin on-orbit checkout and in-flight calibration.	d on Air Force test satellite into orbit. lopment of new medium earth orbit										
(U)											
<ul> <li>MAJOR THRUST: Develop technology to warn of spacecra hazards and to provide space environment situational awaren Department of Defense space systems.</li> </ul>		1.010	0.765	0.801	0.837						
(U) In FY 2006: Developed filter-based optimization algorithms utilizing complete inputs available from compact environmen sensor design and finalize requirements and conceptual desig impact effect distributed anomaly resolution and spacecraft e of compact environment anomaly sensor to diagnose severe n active wave radiation belt remediation experiment.	anomaly sensor. Determined impact of radiation, plasma, chemical, and fects sensor suite. Completed construction										
<ul> <li>(U) In FY 2007: Employ full energy spectra algorithms to converse sensor data bases into dynamic climatological model for anon Commence construction of hardware for space demonstration sensor. Calibrate and integrate compact environment anomal</li> </ul>	aly resolution and space system design. of the distributed anomaly resolution										
Project 5021	R-1 Line Item No. 28 Page-18 of 28			Exhibit R-2a (	PE 0603401F)						
	508										

Exhib	it R-2a, RD	T&E Projec	t Justifica	tion			DATE	February	2007
BUDGET ACTIVITY <b>3 Advanced Technology Development (AT</b>	D)		0603	UMBER AND TI 3401F Advan hnology	TLE Iced Spacecr		PROJECT NUME		
<ul> <li>U) B. Accomplishments/Planned Program (\$ i environment on Air Force test satellite.</li> <li>U) In FY 2008: Analyze data from compact environment for space system design. Continue distributed anomaly resolution sensor. Integri severe radiation environment on Air Force te</li> <li>U) In FY 2009: Continue construction of hardwresolution sensor. Perform verification and vidiagnosing- severe radiation environment.</li> </ul>	ironment anoma construction of ate compact env st satellite. are for space der	hardware for sp ironment anom nonstration of t	pace demonstra aly sensor for the distributed	ation of the diagnosing anomaly	<u>FY 2(</u>		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
U) Total Cost					4.4	28	4.806	4.866	5.292
<ul> <li>U) <u>C. Other Program Funding Summary (\$ in FY 2006</u> <u>Actual</u></li> <li>U) PE 0602601F, Spacecraft Technology.</li> <li>U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimat</u>			Total Cost
Project 5021			R-1 Line Item No Page-19 of 28 509 INCLASSIF	3				Exhibit R-2a (I	PE 0603401F

		Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on			DATE	February	2007
	BET ACTIVITY dvanced Technology Developm	ent (ATD)				IBER AND TITL 01F Advance ology			OJECT NUMBE		chnology
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	· ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5083	Ballistic Missiles Technology Quantity of RDT&E Articles	3.488	3.901 0	5.847	6.197 0	6.472 0	<u>6.625</u> 0	6.611 0	6.607 0	Continuing	TBD
(U)	A. Mission Description and Budget			0	0	0	0	0	0		
	This project develops, integrates, and developing robust, low maintenance i precision instrumentation for next ger <b>B. Accomplishments/Planned Prog</b>	nertial navigat neration missile	ion instrument e systems.					provide new,			n FY 2009
(U)	MAJOR THRUST: Develop, integra to emerging vehicle designs and othe Provide critical missile technology co systems.	ite, and demon r technologies	strate advance that sustain cu	rrent strategic	e missile syste	ms.	<u>1120</u> 1.7		1.951	2.924	3.099
	In FY 2006: Explored laboratory pro navigation instrumentation designs. F demonstration units. Performed engine provided improvements to meet estab	Fabricated initiates in the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second se	al navigation oment tests. E	instruments a	nd engineering	5					
(U)	In FY 2007: Develop and integrate e ground test in environments relevant and provide improvements to meet esplanning.	to subsequent	flight test cond	litions. Evalu	ate system per	rformance					
	In FY 2008: Continue next generation ground test in relevant strategic envir performance goals. Continue flight to verification and testing.	onments, and e	evaluate design	n improvemer	nts against esta	ublished					
(U)	In FY 2009: Continue engineering sy performance improvements. Conduc demonstration flight units. Initiate sy vehicle designs.	t flight qualific	cation testing a	and evaluation	of candidate	-					
(U) (U)	MAJOR THRUST: Develop, integra vehicle designs to provide robust, fle:			-	-		1.7	44	1.950	2.923	3.098
Proj	ect 5083				Line Item No. 2 Page-20 of 28 510	8				Exhibit R-2a (F	PE 0603401F)

		Exhibit	R-2a, RD	T&E Projec	t Justifica	tion			DATE	February	2007	
	GET ACTIVITY dvanced Technology Developr	nent (ATD)	)		0603	UMBER AND TI 3401F Advan hnology	TLE ced Spacecr		ROJECT NUMBE 083 Ballistic			
(U)	<b>B. Accomplishments/Planned Pro</b>	gram (\$ in	<u>Millions)</u>				<u>FY 20</u>	<u>)06 I</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	
(LI)	systems. In FY 2006: Developed long-term	nlan for sled	testing of hig	h gravitational	force tolerant	navigation						
(0)	instrumentation and range safety de environments. Designed system lev	vices. Char	acterized instr	umentation per	rformance in qu	•						
(U)	In FY 2007: Continue long-term pl with test facilities in preparation for instrumentation and range safety de range safety devices with associated communication interfaces in 100 tim	anning and sled testing vices. Meas platform hannes the grav	initiate long-le g of high-gravit sure performar ardware, powe itational force	ead hardware ad tational force to nee of navigation er sources, supp flight-like vibu	equisition and outputsition and outputsion of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the content of the c	ion tion and ınd						
(U) (U)	Continue system level design interf In FY 2008: Complete test plannin tolerant navigational instrumentation demonstrations. Continue performa devices with associated hardware an Validate system design refinements instrumentation and range safety de In FY 2009: Measure and evaluate	g, integratio n and range unce evaluat nd software and initiate vices with n performance	n, and conduct safety devices ion of navigati interfaces in re long-term plat ew vehicle des e of advanced	t sled testing of in preparation ion instrumenta elevant dynami n for flight test signs. navigation inst	for future flig ation and range ic and hostile e ting advanced r trumentation at	ht test safety nvironments. navigational nd range						
(U)	safety devices from experimental te long-lead hardware acquisition for t devices with new vehicle design int system level interfaces. Total Cost	light testing	advanced nav	vigational instru	umentation and	l range safety	3.4	188	3.901	5.847	6.197	
(U)	C. Other Program Funding Sumn	<u>nary (\$ in N</u>	<u> Iillions)</u>									
		FY 2006 Actual	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> Complete	Total Cost	
(U)	PE 0601102F, Defense Research Sciences. PE 0602601F, Space Technology. PE 0603311F, Ballistic Missile Technology.											
Pro	ect 5083			I	R-1 Line Item No Page-21 of 28	-				Exhibit R-2a (I		
110					511	)					L 00034011 )	

Exhibit R-2a, RDT&E Pr	DATE February 2007		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology		T NUMBER AND TITLE Ballistic Missiles Technology
<ul> <li>U) <u>C. Other Program Funding Summary (\$ in Millions)</u></li> <li>U) PE 0603601F, Conventional Weapons Technology.</li> <li>U) PE 0603851F, Intercontinental Ballistic Missile-Dem/Val.</li> <li>U) PE 0604851F, Intercontinental Ballistic Missile-EMD.</li> <li>U) PE 0605860F, Rocket System Launch Program-Space.</li> <li>U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>			
Project 5083	R-1 Line Item No. 28 Page-22 of 28		Exhibit R-2a (PE 0603401F

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on				DATE	February	2007
	GET ACTIVITY dvanced Technology Developme	ent (ATD)				IBER AND TITL 01F Advanc ology		aft			ER AND TITLE	
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 201		FY 2013	Cost to	Total
6001		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimat		Estimate	Complete	
682J	Spacecraft Vehicles Quantity of RDT&E Articles	17.367 0	31.119	11.303	8.740	10.098	10.716	12.1	0	12.398	Continuing	TBD
Note	Funds for the FY 2007 Congressiona			Ŷ	*		*	were mov	-		Let to PE 0603	1 789F
from (U)	Advanced Development, Project 63421 PE 0603211F, Aerospace Technology <b>A. Mission Description and Budget</b> This project develops and demonstrate technologies, including cryogenic coo Energy storage work focuses on lighty year) satellite missions. The project's systems.	Development Item Justifica es compact, lou ling technolog weight nickel h	and Demonst <u>tion</u> w-cost, spacec ies. Power ge ydrogen and s	ration, Project raft and laund neration active codium sulfur	t 63486U, to th ch vehicle pow vities focus on spacecraft bat	nis PE, for exe er generation, lightweight, lo teries and flyv	storage, distr ow-cost, low- vheel energy s	ibution, an volume, ar storage sys	d theri id surv tems f	nal manag ivable sola or extendeo	ement r cell arrays. d (five to ten	
(U) (U) (U) (U)	<ul> <li>MAJOR THRUST: Developed and evaluated performance of space conventional power generation</li> <li>MAJOR THRUST: Developed and evaluated performance of space conventional power generation</li> <li>1.351</li> <li>2.103</li> <li>2.355</li> <li>2.327</li> <li>technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible solar cell arrays, and radiation resistant solar cell modules.</li> <li>In FY 2006: Completed space environmental testing of thin-film solar cells and modules. Performed radiation testing of lattice mismatch multi-junction solar cells.</li> <li>In FY 2007: Perform radiation testing of five to six junction solar cells. Construct flight hardware for thin-film solar array. Demonstrate roll-to-roll production of thin-film solar cells on polymer substrates.</li> <li>In FY 2008: Complete fabrication of flight hardware for Thin-Film Radiation Exposure flight experiment. Complete ground portion of on-orbit prediction model for thin-film solar cells. Develop interconnect technologies for advanced multijunction solar cell structures.</li> </ul>											
	MAJOR THRUST: Develop technolo cryocoolers and integration componer In FY 2006: Completed development demonstrated performance of cryocoo environment. Improved performance	ts for space and of low tempe and contro	oplications. rature flight-q l electronics in	ualified high on the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of t	capacity cryoc	ooler and a relevant	0.8	78	1.4	482	1.330	1.044
Proj	ect 682J				Line Item No. 28 Page-23 of 28 513	8					Exhibit R-2a (P	E 0603401F)

	Exhibit R-2a, RDT&E Project J	DATI	DATE February 2007			
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Technology	d Spacecraft		ABER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	heat exchangers.					
(U)	In FY 2007: Assess various advanced technologies such as micro-electro-mech and other concepts to further reduce cryocooler mass and improve performance f					
	situational awareness applications. Initiate advanced concept development progr	1				
	multi-temperature and large focal plane cooling requirements for space-based sp	••				
	other mission applications.					
(U)	In FY 2008: Complete design and begin development of a non moving parts cor	npressor using proton				
	biased membrane technology. Complete design and begin development of a low					
	cross gimbal 35 K cooling loop interface to support space tracking missions. Co					
	begin development of an improved thermal interface material doubling conductiv					
	space cooling applications. Complete comprehensive study and begin technolog satellite cryogenic interface requirements and improved technologies to support a					
	applications.	space tracking				
(U)	In FY 2009: Continue development of a non moving parts compressor using pro-	ton biased membrane				
	technology. Continue development of a low vibration conductance, cross gimba					
	interface to support space tracking missions. Continue development of an impro					
	material doubling conductive transfer capacity in space cooling applications. Co					
	development of satellite cryogenic interface requirements and improved technolo	ogies to support space				
(U)	tracking applications					
(U)	MAJOR THRUST: Develop composites for launch vehicle and spacecraft struct	ures and space	1.659	3.657	5.229	2.965
(-)	applications, such as launch vehicle shrouds, thermal protection structures, and s	-				
	In FY 2008, increase in funding is due to acceleration of the thermal management	—				
(U)	In FY 2006: Developed ultra-lightweight, high-structural efficiency mirror supp	-				
	mirrors. Demonstrated qualification-level performance of all-composite payload	adapters and fairing				
(II)	structures for Evolved Expendable Launch Vehicles.	····1····1···1·				
(0)	In FY 2007: Demonstrate space qualification-level performance for large diame fairing. Transition multi-functional structures technology to unmanned aerial ve					
	community. Demonstrate space qualification-level performance for 25-meters lo					
	deployable structures.	mg unungnen ergne				
(U)	In FY 2008: Develop symbiotic structural technologies for large deployable stru	ctural sensors and				
		ine Item No. 28				
Pro	jject 682J Pr	age-24 of 28 514			Exhibit R-2a (	PE 0603401F)

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	DATE February 2007		
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Technology	l Spacecraft		ABER AND TITLE		
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> improved thermal management sensors. Perform flight-qualification tests of novel of architectures, cryogenic tanks, and launch vehicle structural components. Develop testbed.	thermal management	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	In FY 2009: Fly elastically-deployed, stored strain energy, deployable structural arc shape memory alloy reinforced hinges. Develop and test thermal management hard	-					
(U) (U)	MAJOR THRUST: Develop technologies for spacecraft structural controls and med applications such as advanced high power solar array subsystems, sensitive payload and miniature payload isolation systems.		1.666	2.857	2.389	2.404	
(U)	In FY 2006: Developed rapid-slew, fast tracking gimbal technology to allow sub-or situational awareness missions. Demonstrated space qualification-level performanc vibration isolation systems for optical payloads.	-					
(U)	In FY 2007: Ground demonstrate full multi-axis flywheel attitude control system we storage. Demonstrate space qualification-level performance for passive vibro-acoust to mitigate launch vehicle acoustic loads. Flight demonstrate on-orbit docking and the mechanisms.	stic damping devices					
(U)	In FY 2008: Implement estimation algorithm for improved local situational awaren on-orbit asset.	ess using on existing					
(U)	In FY 2009: Begin implementation of advanced estimation algorithms for improved awareness onto flight hardware prototype under development.	d local situational					
(U) (U)	CONGRESSIONAL ADD: Beta Energy Cells (BEC) for Defense and Intelligence	Applications.					
(U) (U)	In FY 2006: Conducted Congressionally-directed effort for Beta Energy Cells (BEC Intelligence Applications. In FY 2007: Not Applicable.		4.067	0.000	0.000	0.000	
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U) (U) (U)	CONGRESSIONAL ADD: Thin Film Amorphous Solar Arrays. In FY 2006: Conducted Congressionally-directed effort for Thin Film Amorphous So In FY 2007: Conduct Congressionally-directed effort for Thin Film Amorphous So	-	3.873	10.361	0.000	0.000	
Pro		Item No. 28 -25 of 28			Exhibit R-2a (I	PE 0603401F)	
Pro	ject 682J Page	-25 of 28 515			Exhibit R-2a (I	PE 0603401F)	

Exhibit R-2a, RDT&E Proje	February	2007			
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advance Technology			ABER AND TITLE	
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Large Automated Production of Expendable La</li> <li>(U) In FY 2006: Conducted Congressionally-directed effort for LAPELS.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for LAPELS.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	aunch Structure (LAPELS).	3.873	2.590	0.000	0.000
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Information Sciences Institute Microsatellite S Demonstration Program.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Information Scien Serial Manufacturing Demonstration Program.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> </ul>		0.000	0.996	0.000	0.000
<ul> <li>U)</li> <li>U) CONGRESSIONAL ADD: Microsatellite Serial Manufacturing. Note: The executed in Project 633834.</li> <li>U) In FY 2006: Not Applicable.</li> <li>U) In FY 2007: Conduct Congressionally-directed effort for Microsatellite Ser</li> <li>U) In FY 2008: Not Applicable.</li> <li>U) In FY 2009: Not Applicable.</li> </ul>		0.000	1.992	0.000	0.000
<ul> <li>(U)</li> <li>(U) CONGRESSIONAL ADD: Photovoltaic Module Development for Lighter</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Conduct Congressionally-directed effort for Photovoltaic Module Air Vehicles.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>		0.000	0.996	0.000	0.000
Project 682J	R-1 Line Item No. 28 Page-26 of 28			Exhibit R-2a (l	PE 0603401F)

		Exhibit	R-2a, RD	T&E Projec	ct Justifica	tion			DATE	February	2007		
	BET ACTIVITY dvanced Technology Develo	opment (ATD	)		0603	UMBER AND TI 3401F Advan hnology	TLE ced Spacecra			CT NUMBER AND TITLE Spacecraft Vehicles			
(U)	<b>B. Accomplishments/Planned</b>	Program (\$ in	Millions)				<u>FY 200</u>	<u>6 I</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	CONGRESSIONAL ADD: Sm	all Low-Cost R	econnaissance	Spacecraft.			0.00	0	1.096	0.000	0.000		
	In FY 2006: Not Applicable.												
	In FY 2007: Conduct Congress	onally-directed	l effort for Sm	all Low-Cost F	Reconnaissance	Spacecraft.							
	In FY 2008: Not Applicable.												
	In FY 2009: Not Applicable.												
(U)	CONCRESSIONAL ADD: Sec	a Situational	A woronoog/Sto	r Trooking Sw	tam		0.00	0	1.594	0.000	0.000		
	CONGRESSIONAL ADD: Spa In FY 2006: Not Applicable.		Awareness/Sta	r Tracking Sys	aem.		0.00	0	1.394	0.000	0.000		
	In FY 2007: Conduct Congress	onally-directed	l effort for Spa	ce Situational	Awareness/Sta	r Tracking							
• •	System.	ionally another		ee Situational	1 1 1 ui ei 1 e 1 e 1 e 1 e 1 e 1 e 1 e 1 e 1 e	Truening							
	In FY 2008: Not Applicable.												
	In FY 2009: Not Applicable.												
(U)													
(U)	CONGRESSIONAL ADD: Ad-	vanced Satellite	e Thermal Con	trol Program.		0.00	0	1.395	0.000	0.000			
	In FY 2006: Not Applicable.												
	In FY 2007: Conduct Congress	onally-directed	l effort for Adv	vanced Satellit	e Thermal Con	trol Program.							
	In FY 2008: Not Applicable.												
	In FY 2009: Not Applicable.						17.04	-	21.110	11 202	0.740		
(U)	Total Cost						17.36		31.119	11.303	8.740		
(U)	<u>C. Other Program Funding Su</u>	<u>mmary (\$ in N</u>	<u>(fillions)</u>										
		<u>FY 2006</u>	<u>FY 2007</u>	FY 2008	<u>FY 2009</u>	<u>FY 2010</u>	FY 2011	<u>FY 2012</u>	FY 2013	Cost to	<u>Total Cost</u>		
		<u>Actual</u>	<u>Estimate</u>	<b>Estimate</b>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	<u>Total Cost</u>		
(U)	Related Activities:												
	PE 0602203F, Aerospace												
	Propulsion.												
• •	PE 0602601F, Spacecraft												
	Technology.												
	PE 0603218C, Research and Support.												
	PE 0603226E, Experimental												
	Evaluation of Major												
					R-1 Line Item No	. 28							
	ect 682J				Page-27 of 28				Exhibit R-2a (PE 0603401F)				

Exhibit R-2a, RDT&E Pr	roject Justification	DATE February 2007
BUDGET ACTIVITY <b>3 Advanced Technology Development (ATD)</b>	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 682J Spacecraft Vehicles
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
Innovative Technologies. U) PE 0603500F, Multi-Disciplinary Advanced Development Space		
Technology. U) This project has been coordinated through the Reliance 21 process to harmonize efforts and		
eliminate duplication. U) <u>D. Acquisition Strategy</u> Not Applicable.		
	R-1 Line Item No. 28	
Project 682J	Page-28 of 28 518	Exhibit R-2a (PE 0603401

#### PE NUMBER: 0603444F PE TITLE: MAUI SPACE SURVEILLANCE SYSTEM

ACTIVITY nced Technology Developme Cost (\$ in Millions) Fotal Program Element (PE) Cost Maui Space Surveillance System Mission Description and Budget I program funds space situational a ration and upgrade of the facility. 1	FY 2006 Actual 45.943 45.943 <b>item Justifica</b> wareness tech Note: In FY 2		FY 2008 Estimate 5.237 5.237		BER AND TITL <b>14F MAUI SF</b> FY 2010 Estimate 6.773	FY 2011 Estimate	EILLANCE S FY 2012 Estimate		Cost to Complete	Total
Fotal Program Element (PE) Cost         Maui Space Surveillance System <b>Mission Description and Budget I</b> program funds space situational a         ation and upgrade of the facility.	Actual 45.943 45.943 <b>item Justifica</b> wareness tech Note: In FY 2	Estimate 50.383 50.383 tion	Estimate 5.237	Estimate 5.338	Estimate	Estimate				Total
Fotal Program Element (PE) Cost         Maui Space Surveillance System <b>Mission Description and Budget I</b> program funds space situational a         ation and upgrade of the facility.	45.943 45.943 <b>item Justifica</b> wareness tech Note: In FY 2	50.383 50.383 tion	5.237	5.338			Estimate	Estimate	Complete	
Maui Space Surveillance System <b>Iission Description and Budget I</b> program funds space situational a ation and upgrade of the facility.	45.943 tem Justifica wareness tech Note: In FY 2	50.383 tion			6.773	1 0 0 0			Complete	1
<b><u>Aission Description and Budget I</u></b> program funds space situational a ration and upgrade of the facility.	<b>tem Justifica</b> wareness tech Note: In FY 2	tion	5.237	5.338		6.888	6.025	6.179	Continuing	TB
program funds space situational a ation and upgrade of the facility.	wareness tech Note: In FY 2			0.000	6.773	6.888	6.025	6.179	Continuing	TE
ion for MSSS Operations and Rese get Activity 3, Advanced Technolo elopments that have military utility	ogy Developm	007, Congress .5 million for nent, since it er	added \$8.0 m the Panoramic nables and der	nillion for the l c Survey Teles	High Accuracy scope and Rap	y Network Det id Response S	termination Sy ystem (PanST	ystem (HAND CARRS). This	S), \$25.0 program is in	
rogram Change Summary (\$ in )	<u>Millions)</u>				EV 20	06	EX 2007		2009	EV 2000
ious President's Rudget										<u>FY 2009</u> 6.699
•										5.338
e							50.505		.237	5.550
5					1.2					
6					-0.0	01	-0.191			
-					-0.0	16				
R/STTR Transfer										
<u>ificant Program Changes:</u> Applicable.										
erformance Metrics										
er Development.										
			R-1	Line Item No. 30 Page-1 of 4	)				Exhibit R-2 (PI	∃ 0603444
	rogram Change Summary (\$ in rogram Change Summary (\$ in rent PBR/President's Budget Adjustments gressional Program Reductions gressional Rescissions gressional Increases rogrammings R/STTR Transfer <u>ificant Program Changes:</u> Applicable.	rogram Change Summary (\$ in Millions) ious President's Budget ent PBR/President's Budget 1 Adjustments gressional Program Reductions gressional Rescissions gressional Increases rogrammings R/STTR Transfer <u>ificant Program Changes:</u> Applicable. erformance Metrics	rogram Change Summary (\$ in Millions) ious President's Budget rent PBR/President's Budget 1 Adjustments gressional Program Reductions gressional Rescissions gressional Increases rogrammings R/STTR Transfer <u>ificant Program Changes:</u> Applicable. erformance Metrics	ious President's Budget ent PBR/President's Budget 1 Adjustments gressional Program Reductions gressional Rescissions gressional Increases rogrammings R/STTR Transfer <u>ificant Program Changes:</u> Applicable. erformance Metrics er Development.	rogram Change Summary (\$ in Millions) ious President's Budget ent PBR/President's Budget 1 Adjustments gressional Program Reductions gressional Rescissions gressional Increases rogrammings R/STTR Transfer <u>ificant Program Changes:</u> Applicable. erformance Metrics er Development. R-1 Line Item No. 30	rogram Change Summary (\$ in Millions)          rogram Change Summary (\$ in Millions)       FY 20         ious President's Budget       47.1         ent PBR/President's Budget       45.9         1 Adjustments       -1.2         gressional Program Reductions       -1.2         gressional Rescissions       -0.0         gressional Increases       -0.0         rogrammings       -0.0         RSTTR Transfer       -1.2         ificant Program Changes:       Applicable.         erformance Metrics       er Development.         R-1 Line Item No. 30       Page-1 of 4         519       519	rogram Change Summary (\$ in Millions) ious President's Budget 47.166 tent PBR/President's Budget 45.943 1 Adjustments -1.223 gressional Program Reductions gressional Rescissions -0.001 gressional Increases rogrammings -0.016 R/STTR Transfer -1.206 ificant Program Changes: Applicable. erformance Metrics er Development. R-1 Line Item No. 30 Page-1 of 4 519	rogram Change Summary (\$ in Millions) ious President's Budget 47.166 6.074 ent PBR/President's Budget 45.943 50.383 1 Adjustments -1.223 gressional Program Reductions gressional Increases -0.001 -0.191 gressional Increases -0.016 R/STTR Transfer -1.206 ificant Program Changes: Applicable. erformance Metrics er Development. R-1 Line Item No. 30 Page-1 of 4 519	rogram Change Summary (\$ in Millions) ious President's Budget <u>FY 2006</u> FY 2007 FY ious President's Budget <u>45,943</u> 50.383 3 1 Adjustments <u>-1.223</u> gressional Rescissions <u>-0.001</u> -0.191 gressional Rescissions <u>-0.0016</u> R/STR Transfer <u>-1.206</u> ificant Program Changes: Applicable. erformance Metrics er Development. R1 Line Item No. 30 Page-1 of 4 S19	rogram Change Summary (\$ in Millions) ious President's Budget 47.166 6.074 6.173 ent PBR/President's Budget 45.943 50.383 5.237 I Adjustments -1.223 gressional Program Reductions gressional Rescissions -0.001 -0.191 gressional Increase 44.500 rogrammings -0.016 KSTTR Transfer -1.206 ificant Program Changes: Applicable. erformance Metrics er Development. R-1 Line Item No. 30 Page-1 of 4 Exhibit R-2 (PE

		Exhibit R-	2a, RDT&I	E Project 、	Justificatio	on			DATE	February	2007
	GET ACTIVITY Advanced Technology Developme	ent (ATD)			06034	IBER AND TITL 44F MAUI S EILLANCE S	PACE	48	OJECT NUMBE 68 Maui Spa vstem	ER AND TITLE ace Surveilla	ance
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
4868	8 Maui Space Surveillance System	Actual 45.943	Estimate 50.383	Estimate 5.237	Estimate 5.338	Estimate 6.773	Estimate 6.888	Estimate 6.025	Estimate 6.179	Complete Continuing	TBD
4600	Quantity of RDT&E Articles	43.943	0	0	0	0.775	0.000	0.023	0.179	Continuing	
(U)	<b>A. Mission Description and Budget</b> This program funds space situational a operation and upgrade of the facility. million for MSSS Operations and Res Budget Activity 3, Advanced Technol developments that have military utility	awareness tech Note: In FY 2 search, and \$11 logy Developn	nnology develo 2007, Congress 1.5 million for nent, since it e	s added \$8.0 n the Panorami nables and de	nillion for the c Survey Tele	High Accurac scope and Rap	cy Network De pid Response S	etermination S System (PanS'	ystem (HANI TARRS). Thi	DS), \$25.0 s program is i	
(U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST/CONGRESSION, awareness technology at the Maui Sp upgrade the facility. Note: This effor	AL ADD: Dev ace Surveillan	velop, demons ce System (MS	SSS) in Hawa	ii, as well as o	perate and	<u>FY 20</u> 26.7		<u>¥ 2007</u> 30.957	<u>FY 2008</u> 5.237	<u>FY 2009</u> 5.338
(U)	In FY 2006: Continued MSSS operate customers and experimenters, with the critical sensor and telescope spares, co- increased efficiency, while maintaining Force regulations. Significantly imprest- ever ground-to-space image of an absolute performance limits of imagin optical system designers within the D	tions, research e focus on spa ontinued to rel ng requirement oved computa n operational s ng systems. Th	, and developrice situational a furbish the control of safety ar tional imaging satellite. Establese techniques	nent supportir awareness (SS atrol rooms an ad security in a g technology a plished technic s are being tra	ng various ope SA). Procured ad upgrade con accordance wi and demonstrat ques for defini unsitioned to a	rational additional nputers for th Air ted the ng the					
(U) (U)	In FY 2007: Continue MSSS researce various operational customers and ex- maintaining requirements for safety a concepts for SSA, space system chara- mission effectiveness, and evaluate tr Initiate development of a state-of-the- Continue development of high perfor- identify unique electro-optical phenon- identification, and anomaly resolution In FY 2008: Continue MSSS researce	perimenters. On security in acterization, ar ansition opportant, high-performance and ultimenologies that for satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of the satellite of th	Continue refur accordance wi ad active track tunities of tech ormance sodiu ra-precise astro at can cost-effe owner/operator	bishing and up ith Air Force r ing. Assess m hnology to Air m beacon ada odynamics tec ectively provides.	pgrading MSS regulations. D nilitary utility, r Force Space ptive optics sy chniques. Con de health/statu	S, and evelop optimize Command. /stem. tinue to s,					
Pro	ject 4868			R-1	Line Item No. 3 Page-2 of 4	0				Exhibit R-2a (P	PE 0603444F)
				UN	520 CLASSIFIE	D					

		Exhibit	: R-2a, RD	F&E Projec	ct Justifica	tion			DATE	February	2007	
-	GET ACTIVITY Advanced Technology Deve	lopment (ATD	)		0603	UMBER AND TI 3444F MAUI VEILLANCE	SPACE	4	PROJECT NUMBER AND TITLE 4868 Maui Space Surveillance System			
(U)	<b>B. Accomplishments/Planned</b> customers and experimenters. requirements for safety and sec SSA, space system characteriza high-performance sodium beac	Continue refurbi surity in accordant ation and active	ishing and upg nce with Air Fe tracking. Cont	orce regulation	ns. Develop con	ncepts for	<u>FY 20</u>	<u>)06 I</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Continue MSSS r customers and experimenters. missions, and maintaining requ regulations. Develop concepts development of a state-of-the-a	Continue refurbi irements for safe for SSA, space	ishing and upg ety and securit system charact	rading MSSS to the second second and the second and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second se	to accommodat e with Air Forc active tracking	e those ce . Continue						
(U) (U) (U)	CONGRESSIONAL ADD: Pa In FY 2006: Conducted Congr	•	-		onse System (Pa	an-STARRS).	9.6	505	11.456	0.000	0.000	
(U) (U) (U)	In FY 2009: Conducted Congress In FY 2007: Conduct Congress In FY 2008: Not Applicable. In FY 2009: Not Applicable.	•										
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Hi In FY 2006: Conducted Congr In FY 2007: Conduct Congress In FY 2008: Not Applicable.	ressionally-direct	ted effort for H	IANDS.	n (HANDS).		9.606		7.970	0.000	0.000	
(U) (U)	In FY 2008: Not Applicable. Total Cost						45.9	943	50.383	5.237	5.338	
(U)	C. Other Program Funding St	•										
		<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	Total Cost	
(U) (U)	Related Activities: PE 0602605F, Directed Energy Technology. PE 0603605F, Advanced Weapons Technology.											
(U)	PE 0602500F,				R-1 Line Item No Page-3 of 4	. 30				Exhibit R-2a (F		

Exhibit R-2a, RDT&E P	roject Justification	DATE February 2007
BUDGET ACTIVITY D3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603444F MAUI SPACE SURVEILLANCE SYSTEM	T NUMBER AND TITLE
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
Multi-Disciplinary Space		
Technology.		
J) PE 0603500F, Multi Dissipliners Advanced		
Multi-Disciplinary Advanced Development Space		
Technology.		
U) PE 0603883C, Ballistic		
Missile Defense Boost Phase		
Segment.		
U) This project has been		
coordinated through the		
Reliance process to harmonize efforts and eliminate		
duplication.		
U) <u>D. Acquisition Strategy</u>		
Not Applicable.		
	P 1 Line Itom No. 20	
Project 4868	R-1 Line Item No. 30 Page-4 of 4	 Exhibit R-2a (PE 0603444
	522	
	UNCLASSIFIED	

#### PE NUMBER: 0603500F PE TITLE: MULTI-DISCIPLINARY ADV DEV SPACE TEC

	Ex	DATE	DATE February 2007								
	JDGET ACTIVITY PE NUMBER AND TITLE 3 Advanced Technology Development (ATD) PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE										
	Cost (\$ in Millions)	FY 2009 Estimate					Cost to Complete	Total			
	Total Program Element (PE) Cost	51.929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5031	Advanced Optics & Laser Space Tech	19.938	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5033	Rocket Propulsion Demonstration	25.066	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
5034	Advanced Space Sensors	6.925	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2007, Project 635031 efforts transfer to PE 0603605F, Project 6311SP, Advanced Optics and Laser Space Technology; Project 635032 efforts transfer to PE 0603112F, Advanced Materials for Weapons Systems, Project 6377SP, Advanced Space Materials; Project 635033 efforts transfer to PE 0603216F, Aerospace Propulsion and Power Technology, Project 6310SP, Space Rocket Propulsion Demonstration; Project 635034 efforts transfer to PE 0602203F, Advanced Aerospace Sensors, Project 6388SP, Advanced Space Sensors; and Project 635062 efforts transfer to PE 0603211F, Aerospace Technology Development/Demonstration, Project 6399SP, Advanced Structures Space Vehicles, in order to more effectively manage and provide oversight of the efforts.

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

This program develops and demonstrates multi-disciplinary space technologies focusing on separate technology areas including: 1) advanced optics and laser space technology demonstrates and assesses space unique advanced optics and high energy laser weapon systems capabilities; 2) advanced space materials develop and demonstrate materials and processing technologies for future space vehicle components and protection of space sensors from a variety of laser threats; 3) rocket propulsion develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques for launch and spacecraft applications; 4) advanced space sensors develops and demonstrates sensor technologies for intelligence, surveillance, and reconnaissance, communications, targeting, and electronic counter-countermeasures for spacecraft applications; and 5) advanced structures for space vehicles develop space unique requirements for a horizontally launched transatmospheric vehicle operating in an extreme environment. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing space system upgrades and/or new space system developments that have military utility and address warfighter needs.

	R-1 Line Item No. 31	
	Page-1 of 11	Exhibit R-2 (PE 0603500F)
-	523	

Exhibit R-2, RDT&E Bu	dget Item Justification		DATE Februai	ry 2007			
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPL	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPA					
(U) <b><u>B. Program Change Summary (\$ in Millions)</u></b>							
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U) Previous President's Budget	55.732	0.000	0.000	0.000			
(U) Current PBR/President's Budget	51.929	0.000	0.000	0.000			
(U) Total Adjustments	-3.803						
(U) Congressional Program Reductions							
Congressional Rescissions	0.028						
Congressional Increases							
Reprogrammings	-2.595						
SBIR/STTR Transfer	-1.236						
(II) Significant Dragment Changes							

(U) Significant Program Changes:

Efforts transfer to other programs in FY 2007 and out to more effectively manage and provide oversight of the efforts. Other changes to this PE since the Previous President's Budget are due to higher Air Force priorities.

C. Performance Metrics

(U) Under Development.

R-1 Line Item No. 31 Page-2 of 11 Exhibit R-2 (PE 0603500F) 524

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
	et activity Ivanced Technology Developme	ent (ATD)			06035	IBER AND TITL 00F MULTI-I PACE TEC		RY ADV 50	OJECT NUMBE 31 Advance bace Tech	ER AND TITLE d Optics & I	_aser
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5031	Advanced Optics & Laser Space Tech	19.938	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
effecti (U) <u>A</u> T	In FY 2007, efforts transfer to PE 00 vely manage and provide oversight o <b>A. Mission Description and Budget</b> This project provides for the demonstrative apons.	503605F, Adv f the efforts. Item Justifica	anced Weapor	ns Technology	y, Project 6311		l Optics and L	aser Space Te			
(U) 1 (U) 1 (U) 1 (U) 1 (U) 1 (U) 1	<b>3. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop advance control; beam acquisition, tracking, an ightweight optics; and optical coating greatly extend the range of high-powe in FY 2006: Planned a demonstration and the scoring beam through the rela- ability to apply advanced high energy ightweight silicon carbide primary me electro-mechanical system integration in FY 2007: Not Applicable.	ed, long-range, nd pointing; ac gs that support er laser weapon to actively tra- y and differen laser optical c irrors. Design	optical technical technical technical technical aptive optics; relay mirror sons, as well as lack a cruise mitially pointing coatings on a trued and built a	dual line-of-s systems. Rela ow-power im issile by relay them at the o hree-meter dia lightweight m	sight pointing; y mirror syste aging systems ving both the il output. Demor ameter substra nirror/micro	large, ms can  luminator astrated the te such as	<u>FY 20</u> 2.9		<u>Y 2007</u> 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U) I (U) I (U) I (U) I	n FY 2009: Not Applicable. MAJOR THRUST: Perform atmosph ncluding relay mirror systems, satelli n FY 2006: Tested advanced laser-be elescope to increase imaging resoluti at short wavelengths. Demonstrated a propagation to low-earth-orbit (LEO) n FY 2007: Not Applicable. n FY 2008: Not Applicable.	ite tests and dia eacon adaptive on/laser beam and characteriz	agnostics, and optics system control. Perfo zed performan	high-resolution on Starfire O ormed high-re- ce of point-ah	on satellite im optical Range 3 colution satell lead compensa	aging. 3.5 meter ite imaging	4.7	07	0.000	0.000	0.000
	ct 5031				Line Item No. 3 Page-3 of 11 525	1				Exhibit R-2a (P	E 0603500F)

	Exhibit	R-2a, RD	ſ&E Projec	t Justifica	ation			DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Deve	elopment (ATD	)		060	NUMBER AND TI 3500F MULTI V SPACE TEC	I-DISCIPLINA	RY ADV	PROJECT NUMB 5031 Advance Space Tech	ER AND TITLE	
<ul> <li>(U) <u>B. Accomplishments/Plannee</u></li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	d Program (\$ in	<u>Millions)</u>				<u>FY 20</u>	)06	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop a propagation through severe an</li> <li>(U) In FY 2006: Completed integration through atmosphere</li> </ul>	d/or extended atn ration of first pha	nospheric turb se ground test	ulence. system for cha	racterization	of laser	12.3	315	0.000	0.000	0.000
<ul> <li>advanced adaptive optical and</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>		-	• •		lesieu					
(U) Total Cost						19.9	938	0.000	0.000	0.000
<ul> <li>(U) <u>C. Other Program Funding S</u></li> <li>(U) PE 0602605F, Directed Energy Technology.</li> <li>(U) PE 0603444F, Maui Space Surveillance System.</li> <li>(U) PE 0603605F, Advanced Weapons Technology.</li> <li>(U) PE 0603883C, Ballistic Missile Defense Boost Phase Segment.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>	<u>FY 2006</u> <u>Actual</u>	FY 2007 Estimate	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate		<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Project 5031				R-1 Line Item N Page-4 of 1 526 <b>INCLASSIF</b>	1				Exhibit R-2a (P	'E 0603500F)

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Exhibit R-2a, RDT&E	Project Justification	DATE February 2007
BUDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC	PROJECT NUMBER AND TITLE 5031 Advanced Optics & Laser Space Tech
U) <b>D. Acquisition Strategy</b>		
Not Applicable.		
	R-1 Line Item No. 31	
Project 5031	Page-5 of 11	Exhibit R-2a (PE 0603500P
	UNCLASSIFIED	

	Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Developm	ent (ATD)			06035	IBER AND TITL 00F MULTI-I SPACE TEC		RY ADV 50	OJECT NUMBE 33 Rocket P monstratio	ropulsion	
Cost (\$ in Millions)	Inced Technology Development (ATD)           Cost (\$ in Millions)         FY 2006         FY 2007         F           Actual         Estimate         E           Rocket Propulsion Demonstration         25.066         0.000           Quantity of RDT&E Articles         0         0           FY 2007, efforts transfer to PE 0603216F, Aerospace Propulsion at y manage and provide oversight of the efforts.         Mission Description and Budget Item Justification           s project develops and demonstrates advanced and innovative low-inologies, and advanced propellants for launch and orbit transfer p trategic Systems Phase 1. Characteristics such as environmental at launch costs are emphasized. Increased life and performance of p fact propulsion system technologies for stationkeeping and on-orbit upact, lightweight, advanced propullants. Technological advances abilities by ~20 percent, and reduce launch, operations, and suppor anced for reusable launch systems. Technology advances could al euvering capability, a 25 percent reduction in orbit transfer operate te Integrated High Payoff Rocket Propulsion Technology program rt to focus rocket propulsion technology on national space launch           Accomplishments/Planned Program (\$ in Millions)           JOR THRUST: Develop liquid rocket propulsion technology for icles.           TY 2006: Scaled-up and tested advanced lightweight thrust chamb led-up advanced cryogenic upper stage technologies including hig tems.           TY 2007: Not Applicable.           TY 2008: Not Applicable.					FY 2011	FY 2012	FY 2013	Cost to	Total
· · · · ·			Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
			0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
		÷	0	r Tashnalagy	0	0 D Space Dec	0	0 Demonstrativ	n in order to	more
		space riopuis	ioli allu Fowe	r reciniology,	rioject 05105	or, space Roc	ket Flopuisioi	i Demonstratio	on, morder u	more
rocket propulsion system technologie compact, lightweight, advanced prop fundamentals), and high-energy prop capabilities by ~20 percent, and reducen enhanced for reusable launch systems maneuvering capability, a 25 percent to the Integrated High Payoff Rocket	s for stationker ulsion systems ellants. Techn ce launch, oper s. Technology reduction in or Propulsion Te	eping and on-o , higher efficie ological advar ations, and su advances coul rbit transfer op chnology prog	orbit maneuve ency energy co aces developed pport costs by d also lead to perational cost gram, a joint D	ring application onversion system d in this progra ~30 percent. seven-year in is, and a 15 per	ons. Technolo ems (derived f am could impr Responsivene crease in satell rcent increase	gy areas investored and impro- ove the performers and operate lite on-orbit tion in satellite page 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 2010 and 201	stigated includ ved understan rmance of exp pility of propu me, a 50 perce yload. The ef	e ground dem ding of combu endable system lsion systems ent increase in forts in this pr	onstrations of istion ns' payload will be satellite oject contribu	ıte
						<u>FY 20</u>		<u> 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	ocket propulsi	on technology	for current ar	nd future space	e launch	13.3	88	0.000	0.000	0.000
(U) In FY 2006: Scaled-up and tested ad	-	-		-						
upper stages, orbit transfer vehicles,	and satellite fo	rmation flying	, station keep	ing, and repos	itioning.	3.5	88	0.000	0.000	0.000
Project 5033				Line Item No. 3 Page-6 of 11	1				Exhibit R-2a (F	PE 0603500F)
				528						

	Exhibit R-2a, RDT&E Project Jus	tification		DA	TE February	2007	
	GET ACTIVITY .dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603500F MULTI-DIS DEV SPACE TEC	SCIPLINARY ADV		UMBER AND TITLE		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	thrusters capable of low-earth-orbit geosynchronous-earth-orbit transfer. Developed	l components for the					
ДD	high-power Hall thruster demonstration. In FY 2007: Not Applicable.						
(U) (U)	In FY 2008: Not Applicable.						
(U)	In FY 2009: Not Applicable.						
(U)							
	MAJOR THRUST: Develop missile propulsion, aging, and surveillance technology	for intercontinental	6.321	0.000	0.000	0.000	
(-)	ballistic missiles to include demonstration of missile propulsion technology and Pos						
	Systems. Note: Efforts completed in FY 2006.						
(U)	In FY 2006: Completed fabrication of final components for the final strategic susta	inment					
	demonstration motors and prepared for test. Completed assessment and fabrication	of the final strategic					
	sustainment demonstration motors.						
	In FY 2007: Not Applicable.						
	In FY 2008: Not Applicable.						
	In FY 2009: Not Applicable.						
(U)	MAJOD TUDUST. Davidon electric and educated chemical based monopropellent	nuonulaion	0.906	0.000	0.000	0.000	
(U)	MAJOR THRUST: Develop electric and advanced chemical based monopropellant technologies for future satellite propulsion systems.	propulsion	0.806	0.000	0.000	0.000	
(U)	In FY 2006: Completed advanced monopropellant thruster demonstration.						
(U)	In FY 2007: Not Applicable.						
(U)	In FY 2008: Not Applicable.						
• •	In FY 2009: Not Applicable.						
(U)							
	CONGRESSIONAL ADD: Upper Stage Engine Technology (USET).		0.963	0.000	0.000	0.000	
	In FY 2006: Provided additional turbo-pump cavitation modeling, simulation, and t	ool development for					
	use in future liquid rocket booster and upper stage engine designs and analysis.						
· /	In FY 2007: Not Applicable.						
• •	In FY 2008: Not Applicable.						
	In FY 2009: Not Applicable.						
(U)	Total Cost		25.066	0.000	0.000	0.000	
		Item No. 31					
Pro		529			Exhibit R-2a (P	E 0603500F)	

Γ		DATE	DATE February 2007									
	OGET ACTIVITY Advanced Technology Deve	lopment (ATD	)		06	0603500F MULTI-DISCIPLINARY ADV 5033 R				CT NUMBER AND TITLE Rocket Propulsion nstration		
(U)	C. Other Program Funding St	ummary (\$ in N	<u>(Iillions)</u>									
		<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> Estimate	<u>FY 2008</u> Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimat</u>				
(U) (U) (U) (U) (U) (U)	PE 0602102F, Materials. PE 0602203F, Aerospace Propulsion. PE 0602601F, Spacecraft Technology. PE 0603114N, Power Projection Advanced Technology. PE 0603216F, Aerospace Propulsion Power Technology. PE 0603401F, Advanced Spacecraft Technology. PE 0603853F, Evolved Expendable Launch Vehicle Program. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. <b>D. Acquisition Strategy</b> Not Applicable.											
Pr	oject 5033			I	R-1 Line Item Page-8 of					Exhibit R-2a (PE 0603500F)		
					530							

		Exhibit R-	2a, RDT&E	E Project	Justificatio	on			DATE	February 2	2007
	GET ACTIVITY dvanced Technology Developme	ent (ATD)			06035	IBER AND TITL OOF MULTI-E PACE TEC			OJECT NUMBE 34 Advance	R AND TITLE d Space Ser	nsors
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5034	Advanced Space Sensors	6.925	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	In FY 2007, efforts transfer to PE 06 ight of the efforts.	03203F, Adva	nced Aerospa	ce Sensors, Pr	oject 6388SP,	Advanced Sp	ace Sensors, i	n order to mor	re effectively	manage and p	rovide
	<b>A. Mission Description and Budget</b> This project develops and demonstrate electro-optical sensors; laser warning developing multi-function radar, laser precisely detect, track, and target air-	es space sensor sensors; target , electronic con and ground-ba	technologies, ing and attack mbat, and ECC sed, high-valu	radar sensors CM technolog	; and electroni ies for space a	ic counter-cou	ntermeasures his project pro hyulnerable to	(ECCM) and ovides space pl hostile and na	communication atforms with the attract of the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon	ons. By the capability	
(U) (U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop and den resistance, positional accuracy, timing defensive combat capabilities.	nonstrate techn	ologies to ma		-	• •	<u>FY 20</u> 2.1		<u>7 2007</u> 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
	In FY 2006: Designed space-based d optimal sensor fusion for a Common simulation technology to assess netwo In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	Operation Pict	ure. Designed	l multi-ship vi	rtual flight tes						
(U) (U)	MAJOR THRUST: Develop space la acquisition/tracking sensors, including power (laser-guided ordnance) signals In FY 2006: Integrated false alarm pa	g detecting and	l locating both	high power (	dazzle/damag	e) and low	1.6	00	0.000	0.000	0.000
	and coordinated on-orbit testing, data technology for space-qualified laser w designators, trackers, dazzlers, and we scenario testbed for satellite-as-a-sense	varning sensors eapons. Comp	s for rapid deter leted develop	ection and cha	aracterization of	of laser					
	In FY 2007: Not Applicable.										
(U)	In FY 2008: Not Applicable.										
Proj	ect 5034				Line Item No. 3 <sup>.</sup> Page-9 of 11	1				Exhibit R-2a (P	E 0603500F)
					531						

Exhibit R-2a, RDT&E Project Justification				DATE February 2007			
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)			PE NUMBER AND TITLE 0603500F MULTI-DISCIPLINARY ADV DEV SPACE TEC		PROJECT NUMBER AND TITLE		
<ul> <li>(U) <u>B. Accomplishments/Planner</u></li> <li>(U) In FY 2009: Not Applicable.</li> </ul>	l Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
support a network-level topolo	advanced laser communication compor gy for Airborne Intelligence Surveillan	nce and Reconnaissance (AISR).	2.877	0.000	0.000	0.000	
of AISR links between an airbo radio frequency/electro-optical applicability of shared aperture	egrated electro-optical communication orne communication testbed and groun apertures to service high bandwidth co es to maintaining air network link conn- ptical network to switch and route high	d terminals. Developed shared ommunication needs. Tested acctivity under in weather					
signals to lower level radio free	quency systems through a distributed find redundancy. Demonstrated a combined acombined acombin	ïber bus providing lower					
(U) In FY 2007: Not Applicable.							
<ul><li>(U) In FY 2008: Not Applicable.</li><li>(U) In FY 2009: Not Applicable.</li></ul>							
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>							
<ul> <li>MAJOR THRUST: Develop, detection and identification of situational awareness. Note: I Advanced Aerospace Sensors,</li> </ul>	demonstrate, and evaluate spectral-tem transient and moving targets for battles n FY 2006, spectral sensing technolog are extended to the space environment	space surveillance and space y efforts from PE 0603203F,	0.319	0.000	0.000	0.000	
sensing for battlespace surveill	ed sensor to evaluate the performance p ance missions. Modeled expected perf ery and tank fire, and battlefield explose	formance for a variety of targets,					
(U) In FY 2007: Not Applicable.							
(U) In FY 2008: Not Applicable.							
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U) Total Cost</li></ul>			6.925	0.000	0.000	0.000	
Project 5034		R-1 Line Item No. 31 Page-10 of 11			Exhibit R-2a (I		

		( K-2a, RD	<b>&amp;E Projec</b>	t Justifica	tion		DATE February 2007		
BUDGET ACTIVITY 03 Advanced Technology Deve	lopment (ATD	)		0603	UMBER AND TI <b>3500F MULT</b> I <b>SPACE TEC</b>	-DISCIPLINA		PROJECT NUMBE	
<ul> <li>(U) <u>C. Other Program Funding S</u></li> <li>(U) PE 0602204F, Aerospace Sensors.</li> <li>(U) PE 0603203F, Advanced Aerospace Sensors.</li> <li>(U) PE 0603270F, Electronic Combat Technology.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>		-	FY 2008 Estimate				FY 2012 Estimat	<u>FY 2013</u>	<u>Cost to</u> <u>Total Cost</u>
Project 5034			I	R-1 Line Item No Page-11 of 11 533					Exhibit R-2a (PE 0603500F)

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#### PE NUMBER: 0603601F PE TITLE: Conventional Weapons Technology

	Ex	hibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007	
BUDGET ACTIVITY BUDGET ACTIVITY BUDGET ACTIVITY BE NUMBER AND TITLE BE V 2006 EX 2007 EX 2008 EX 2009 EX 2010 EX 2011 EX 2012 EX 2013 Cost to Total												
Coat (fin	Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
Cost (\$ in	Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
Total Program El	ement (PE) Cost	35.916	38.512	16.904	13.794	22.140	21.606	19.153	18.929	Continuing	TB	
570A Conventional We Development		35.916	38.512	16.904	13.794	22.140	21.606	19.153	18.929	Continuing	TB	
Note: In FY 2006, the effe	orts covered unde	r Project 670E	8 were moved	to Project 670	DA.							
development of conv seekers, navigation a Atmospheric Visibili Reconnaissance Veh for Next Generation Weapons Data Link. system upgrades and	nd control, and gu ty Sensor; \$1.4 m icle (CERV) for A Fixed Wing S-3B This program is	uidance. Note iillion for Air AFSOC; \$1.4 Heavy Aerial in the Budget	: In FY 2007, Force Special million for the Firefighting 7 Activity 3, Act	Congress add Ops Innovativ Ground Mob Fanker; \$1.4 n Ivanced Techn	led \$2.0 million ve Miniature In ile Gateway S nillion for UA nology Develo	n for Falcon E nfrared Camer ystem; \$3.6 m V Sensor Inter pment, since i	ye Seeker; \$1 a; \$3.2 million illion for Und face and Payl	4 million for for the Cland er Vehicle Mo oads for Targ	Micro-Sized A destine Electri obile Inspectio eting; and \$1.4	Air-Launched c n; \$3.2 million 4 million for	n	
U) <u>B. Program Change</u>		<u>Millions)</u>				<u>FY 20</u>		<u>FY 2007</u>		2008	<u>FY 2009</u>	
U) Previous President's	-					30.5	-	19.658		9.993	21.504	
J) Current PBR/Preside	nt's Budget					35.9		38.512	1	6.904	13.794	
J) Total Adjustments						5.3	97					
J) Congressional Progra Congressional Rescis						0.0	22	-0.146				
Congressional Increa						0.0	23	-0.140 20.400				
Reprogrammings	303					5.9	17	-1.400				
SBIR/STTR Transfer	•					-0.5		11100				
U) Significant Program							-					
Not Applicable.	-											
C. Performance Metr (U) Under Developm	ent.											

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	GET ACTIVITY Advanced Technology Developm	ent (ATD)			06036	IBER AND TITL 01F Conven Iology		ons 6	ROJECT NUMBE 70A Convent evelopment		
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Conventional Weapons	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
670	A Development	35.916	38.512	16.904	13.794	22.140	21.606	19.153	18.929	Continuing	g TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
(U)	<b>A. Mission Description and Budget</b> This program develops, demonstrates, development of conventional ordnance seekers, navigation and control, and g Atmospheric Visibility Sensor; \$1.4 m Reconnaissance Vehicle (CERV) for for Next Generation Fixed Wing S-3E Weapons Data Link. This program is system upgrades and/or new system d	, and integrates e technologies uidance. Note nillion for Air AFSOC; \$1.4 B Heavy Aerial in the Budget	s ordnance and including was In FY 2007, Force Special million for the Firefighting 7 Activity 3, Activity 3, Acti	rheads, fuzes, Congress add Ops Innovativ Ground Mob Fanker; \$1.4 r dvanced Tech	and explosive led \$2.0 millio ve Miniature I vile Gateway S nillion for UA nology Develo	es; and develop on for Falcon E nfrared Camer ystem; \$3.6 m V Sensor Inte opment, since	oment of adva Eye Seeker; \$1 ra; \$3.2 millio nillion for Und rface and Pay	nced guidanc .4 million fo n for the Clar ler Vehicle M loads for Tar	e technologies r Micro-Sized ndestine Electr lobile Inspectio geting; and \$1.	including Air-Launcheo ic on; \$3.2 milli 4 million for	d on
(U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop and der warhead technologies to improve mut airframes, thereby improving sortie e fuzing capability that will transmit fu mediums. Note: In FY 2007, funding	nonstrate adva nition effective ffectiveness an nction data fro g will be reduc	nced air-delive eness, allowing id increasing s im penetrating ced as fuze effo	g for smaller v trike aircraft l weapons thro orts go to a sin	warheads and r load-outs. Dev ough various h ngle demonstra	munition velop a ard target ation.	<u>FY 20</u> 4.0		<u>Y 2007</u> 3.768	<u>FY 2008</u> 3.399	<u>FY 2009</u> 3.442
(U) (U) (U)	In FY 2006: Designed a hard target i access. Developed fuzes that can trar In FY 2007: Continue designing a ha facilities access. Complete developin platform. In FY 2008: Complete initial phase of	nsmit bomb da ard target influe ag fuzes that ca of hard target in	mage informa ence fuze capa in transmit bon nfluence fuze	tion to an airc able of denyin mb damage in development a	raft platform. g hard and dee formation to a and testing. B	eply buried n aircraft egin					
(U)	developing an active imaging target d focused warheads. In FY 2009: Continue developing an selection for mass focused warheads.		-	-							
(U) (U)	MAJOR THRUST: Develop and den	nonstrate conv	entional muni	tion subsyster	n and platform	1	1.8	75	0.241	0.312	1.400
	ject 670A			•	Line Item No. 3 Page-2 of 8 536						PE 0603601F)

	Exhibit R-2a, RDT&E Proj	ect Justification		DATI	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Convention Technology	nal Weapons		BER AND TITLE	
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) integration technologies to include innovative air-delivered munition carri miniature weapon release concepts, and reduced airframe size providing th launch, and communicate with the aerospace vehicle and other multiple m integration technologies will increase weapon load-outs and improve sorti future strike aircraft, while reducing munition airlift requirements.	ne capability to safely carry, iniature weapons. These	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2006: Integrated a miniaturized datalink into a weapon system to p Planned a datalink flight demonstration. Planned a low-cost miniature cru Planned a miniature persistent munition demonstration that will provide an multiple-shot capability.	ise missile demonstration.				
(U)	In FY 2007: Complete a miniaturized datalink flight demonstration. Enha a low-cost miniature cruise missile. Mature plans and begin design of a m that will provide area dominance with a multiple-shot capability. Note: E conducted in the navigation and control technologies activity in this project	iniature persistent munition Datalink flight test will be				
(U)	In FY 2008: Begin development of a small powered short-range precision of attacking multiple moving targets.					
(U)	In FY 2009: Develop a small powered short-range precision-guided subm multiple moving targets. Begin developing a missile with the capability to and highly agile air targets as well as high value ground targets, such as er	o defeat a broad range of small				
(U)						
(U)	MAJOR THRUST: Develop and demonstrate advanced conventional arm including heavy metal liners, dense metal cases, and insensitive explosives performance attributes. The goal of these efforts is to destroy hardened ta penetrating protective surfaces and by enhancing kill mechanisms against	s with increased energy release rgets by more effectively	14.068	6.751	7.063	3.433
(U)	In FY 2006: Improved insensitive explosive warhead fills with a goal to s volume completing the intended ordnance mission. Developed an ordnance improve counter-air lethality against cruise missiles and manned aircraft. warhead package designed for precision-guided submunitions. Developed dispensing payloads within a target for counterforce applications. Test an package designed for low collateral damage and minimum far-field lethali	ce package to significantly Designed a multi-mode I a weapon system capable of d develop an ordnance				
(U)	In FY 2007: Complete insensitive explosive warhead fills that significantly requirements. Continue developing an ordnance package that will significantly and the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second s	y reduce fill volume				
	ject 670A	R-1 Line Item No. 32 Page-3 of 8			Exhibit R-2a (	

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007		
	GET ACTIVITY Advanced Technology Development (ATD)	onal Weapons	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development					
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> lethality against cruise missiles and manned aircraft. Develop and test system package with low collateral damage and minimum far-field lethality. Contin		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	multi-mode warhead package designed for precision-guided submunitions. C weapon system capable of dispensing payloads within a target for counterforce	ontinue developing a						
(U)	In FY 2008: Extend development of an ordnance package with improved courcruise missile and urban targets, as well as attacking a subset of ground target defenses. Continue developing a multi-mode warhead package designed for p submunitions.	s to include enemy air						
(U)	In FY 2009: Demonstrate of an ordnance package with improved counter-air missile and counter-air targets, as well as attacking a subset of ground targets defenses. Demonstrate a multi-mode warhead package designed for precisior	to include enemy air						
(U)		C						
(U)	MAJOR THRUST: Develop and demonstrate advanced conventional armam miniature munitions applications. These seeker technologies will autonomou guide to targets of interest in adverse weather and battlefield conditions. Also will increase the probability of kill and minimize collateral damage, while proload-out and improved sortie effectiveness. Note: In FY 2006 and prior, these under Project 670B in this Program Element. In FY 2007, the Miniature Nav another thrust in this project) will be completed allowing seekers for two different terms.	sly detect, acquire, and b, the seeker technologies oviding increased weapons se efforts were covered igator Demonstration (in	0.000	7.629	6.130	5.519		
	In FY 2006: Not Applicable. In FY 2007: Continue design and fabrication, and commence ground and fligh detection and ranging seeker that reduces moving parts compared to earlier ge plans and begin designing a small multiple-mode radar for an air to surface w Develop ordnance package designed for low collateral damage and minimum	eneration seekers. Mature eapon demonstration.						
(U)	In FY 2008: Continue design and demonstration of low cost laser detection a increase data rates and reduce moving parts compared to earlier generation last Develop a multi-mode radar seeker capable of engaging both moving and stat weather.	ser seeker technologies.						
(U)	In FY 2009: Continue design and demonstration of a low cost laser detection increase data rates and LADAR moving parts compared to earlier generation							
Proi	ject 670A	-1 Line Item No. 32 Page-4 of 8			Exhibit R-2a (I			

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007
	GET ACTIVITY Idvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventi Technology		PROJECT NUM 670A Conve Developmen	ons	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	technologies. Flight test a multi-mode radar seeker capable of engaging both movin targets in adverse weather.	g and stationary				
(U)						
(U)	MAJOR THRUST: Develop and demonstrate advanced conventional armament navitation technologies to increase armament navigation accuracy, improve stand off range, and control and operation in electronic jamming environments. Note: Prior to FY 2006 covered under Project 670B in this Program Element. In FY 2007, the Miniature Nation will be completed allowing seekers for two different munition concert another thrust in this project).	d enhance weapons , these efforts were avigator	5.664	1.626	0.000	0.000
(U)	In FY 2006: Developed and demonstrated a munition navigation system that provid than a meter), miniature (less than 25 cubic inch), and affordable (less than \$6000 pc positioning management system. Developed a capability for weapons to datalink in communications grid.	er unit) global				
(U)	In FY 2007: Complete design and fabrication of a weapon datalink and integrate da munition for commencement of flight testing.	talink into a guided				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: High Speed Strike Weapon.		2.805	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for High Speed Strike Wea	pon.				
(U)	In FY 2007: Not Applicable.					
	In FY 2008: Not Applicable.					
	In FY 2009: Not Applicable.					
(U)	11					
	CONGRESSIONAL ADD: Fuze Air-to-Surface Technology (FAST).		0.967	0.000	0.000	0.000
	In FY 2006: Conducted Congressionally-directed effort for FAST.					
	In FY 2007: Not Applicable.					
	In FY 2008: Not Applicable.					
• •	In FY 2009: Not Applicable.					
(U)	······································					
	CONGRESSIONAL ADD: Internet Protocol (IP) Targeting Extension System.		0.967	0.000	0.000	0.000
Proj		Item No. 32 e-5 of 8			Exhibit R-2a (F	PE 0603601F)
		539				

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007
	GET ACTIVITY Idvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventio Technology	onal Weapons		BER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2006: Conducted Congressionally-directed effort for IP Targeting Extension	System.				
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Plug and Play Capability for Air-Launched Weapons.		0.967	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Plug and Play Capabilit	y for Air-Launched				
	Weapons.					
	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
	In FY 2009: Not Applicable.					
(U)			1.050	1.0.60	0.000	0.000
(U)	CONGRESSIONAL ADD: Air Force Special Ops Innovative Miniature Infrared Ca		1.258	1.363	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Air Force Special Ops I	nnovative Miniature				
(II)	Infrared Camera.	A Contract of the second second second second second second second second second second second second second se				
$(\mathbf{U})$	In FY 2007: Conduct Congressionally-directed effort for Air Force Special Ops Inn	ovative Miniature				
	Infrared Camera.					
	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U) (U)	CONGRESSIONAL ADD: Clandestine Electric Reconnaissance Vehicle (CERV) f	for Air Force Special	1.645	3.116	0.000	0.000
(0)	Operations Command (AFSOC).	of All Porce Special	1.045	5.110	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for CERV for AFSOC.					
	In FY 2007: Conducted Congressionally-directed effort for CERV for AFSOC.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
	CONGRESSIONAL ADD: Micro-Sized Air-Launched Atmospheric Visibility Sense	sor.	1.645	1.363	0.000	0.000
· · ·	In FY 2006: Conducted Congressionally-directed effort for Micro-Sized Air-Launch					
È	Visibility Sensor.	L				
(U)	In FY 2007: Conduct Congressionally-directed effort for Micro-Sized Air-Launcher	d Atmospheric				
		Item No. 32				
Pro		e-6 of 8 40			Exhibit R-2a (I	PE 0603601F)

	Exhibit R-2a, RDT&E Project Jus	tification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITL 0603601F Conven Technology			BER AND TITLE	
(U)	<b>B.</b> Accomplishments/Planned Program (\$ in Millions)		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Visibility Sensor.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Falcon Eye Seeker		0.000	1.947	0.000	0.000
(U)	In FY 2006: Not Applicable.					
(U)	In FY 2007: Conduct Congressionally-directed effert for Falcon Eye Seeker.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)	CONCREGIONAL ADD. Co. al.M.1.'L.C.C. C. C.C.		0.000	1 2 6 2	0.000	0.000
(U)	CONGRESSIONAL ADD: Ground Mobile Gateway System.		0.000	1.363	0.000	0.000
(U)	In FY 2006: Not Applicable. In FY 2007: Conduct Congressionally-directed effort for Ground Mobile Gateway	Stratom				
(U) (U)	In FY 2007. Conduct Congressionary-directed enort for Ground Mobile Gateway In FY 2008: Not Applicable.	System.				
(U)	In FY 2009: Not Applicable.					
(U)	In FT 2009. Not Applicable.					
(U)	CONGRESSIONAL ADD: Under Vehicle Mobile Inspection.		0.000	3.503	0.000	0.000
(U)	In FY 2006: Not Applicable.		0.000	5.505	0.000	0.000
(U)	In FY 2007: Conduct Congressionally-directed effort for Under Vehicle Mobile ins	pection System.				
(U)	In FY 2008: Not Applicable.	F				
(U)	In FY 2009: Not Applicable.					
(U)	11					
(U)	CONGRESSIONAL ADD: Next Generation Fixed Wing S-3B Heavy Aerial Firefi	ghting Tanker	0.000	3.116	0.000	0.000
(U)	In FY 2006: Not Applicable.					
(U)	In FY 2007: Conduct Congressionally-directed effort for Next Generation Fixed W	ing S-3B Heavy				
	Aerial Firefighting Tanker.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Unmanned Air Vehicle (UAV) Sensor Interface and Pa	yloads for	0.000	1.363	0.000	0.000
	Targeting.					
_		Item No. 32				
Pro		e-7 of 8 5 <b>41</b>			Exhibit R-2a (	PE 0603601F)

	Exhibit	R-2a, RD	C&E Projec	t Justifica				DATE	February	2007
UDGET ACTIVITY 3 Advanced Technology Devel	opment (ATD)			0603	UMBER AND TIT 8601F Conve hnology	rle ntional Weap	ons 6	ROJECT NUMB 70A Conven Development	tional Weapo	ons
U) <b><u>B. Accomplishments/Planned</u></b>	Program (\$ in 1	<u>Millions)</u>				<u>FY 20</u>	<u>06 I</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
J) In FY 2006: Not Applicable.		00 . 0 . <b>T</b>			1.0					
J) In FY 2007: Conduct Congress	ionally-directed	effort for UA	V Sensor Inter	face and Paylo	ads for					
Targeting. J) In FY 2008: Not Applicable.										
J) In FY 2009: Not Applicable.										
J)										
J) CONGRESSIONAL ADD: We	apons Data Linl	к.				0.0	00	1.363	0.000	0.000
J) In FY 2006: Not Applicable.			<b>D</b> . II							
<ul><li>J) In FY 2007: Conduct Congress</li><li>J) In FY 2008: Not Applicable.</li></ul>	ionally-directed	effort for We	apons Data Lir	ık.						
J) In FY 2009: Not Applicable.										
J) Total Cost						35.9	16	38.512	16.904	13.79
J) <u>C. Other Program Funding Su</u>		(Illiana)								
<u>C. Other Frogram Funding Su</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	
	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	Estimate	Estimate		<u>Cost to</u>	Total Cos
J) Related Activities:										
J) PE 0602602F, Conventional										
Munitions.										
J) This project has been coordinated through the										
Reliance 21 process to										
harmonize efforts and										
eliminate duplication.										
J) <u>D. Acquisition Strategy</u> Not Applicable.										
Project 670A			I	R-1 Line Item No Page-8 of 8	. 32				Exhibit R-2a (P	E 0603601

#### PE NUMBER: 0603605F PE TITLE: Advanced Weapons Technology

	Ex	hibit R-2,	RDT&E B	udget Item	n Justifica	tion			DATE	- ebruary 2	:007
BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603605F Advanced Weapons Technology											
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	42.124	76.733	43.999	38.877	72.809	57.427	64.922	76.273	Continuing	TBD
11SP	Advanced Optics and Laser Space Tech	0.000	21.323	21.107	18.296	27.505	27.982	28.011	28.875	0.000	0.000
3150	Advanced Optics Technology	10.226	11.955	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151	High Power Solid State Laser Technology	13.240	26.650	12.388	11.428	21.669	16.932	23.569	32.552	Continuing	TBD
3152	High Power Microwave Technology	10.170	12.890	10.504	9.153	23.635	12.513	13.342	14.846	Continuing	TBD
3647	High Energy Laser Technology	8.488	3.915	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD

Note: In FY 2007, Project 11SP, Advanced Optics and Laser Space Technology, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Technology, in order to more effectively manage and provide oversight of the efforts.

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

This program provides for the development and demonstration of advanced directed energy and optical concepts. In solid state lasers, compact, reliable, relatively high power, cost-effective single electric laser devices and arrays of electric laser devices are demonstrated. Technologies such as high power chemical lasers and beam control are also demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. Note: In FY 2007, Congress added \$6.8 million for Applications of LIDAR to Vehicles with Analysis (ALVA), \$1.6 million for the Near Earth Space Surveillance Initiative, \$1.0 million for Mobile Active Targeting Resource for Integrated Experiments, \$2.0 million Laser Spark System Integration, \$1.7 million for Mid-Infrared Semiconductor Laser Technology, \$2.4 million for High Energy Laser - Directed Energy Weapon (HEL-DEW) Scaling Optimization, \$1.0 million for the Hyper/multispectral Data Reduction and Archiving (HyDRA) Project, \$2.6 million for Advanced Weapons and Laser Diode Development, \$5.0 million for Lightweight Multi-purpose Laser, and \$1.6 million for Real-time Optical Surveillance Applications. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

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Page-1 of 21	Exhibit R-2 (PE 0603605F)
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Exhibit R-2, RDT&E Bu	Idget Item Justification		DATE Februai	ry 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weap	oons Technology		
(U) <b><u>B. Program Change Summary (\$ in Millions)</u></b>				
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	49.821	51.336	51.057	53.351
(U) Current PBR/President's Budget	42.124	76.733	43.999	38.877
(U) Total Adjustments	-7.697			
(U) Congressional Program Reductions		-0.012		
Congressional Rescissions	-0.032	-0.291		
Congressional Increases		25.700		
Reprogrammings	-6.629			
SBIR/STTR Transfer	-1.036			
(U) Significant Program Changes:				
In EV 2006 \$4.284 million was renorgrammed into PE 0602800E	High Energy Laser Research as the Air Force co	atribution to the Joint	High Dower Solid St	ata Lasar

In FY 2006, \$4.284 million was reporgrammed into PE 0602890F, High Energy Laser Research, as the Air Force contribution to the Joint High Power Solid State Laser program.

C. Performance Metrics

Under Development.

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Page-2 of 21	Exhibit R-2 (PE 0603605F)
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Tech         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O         O			Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February 2	2007
Cost (S in Millions)         Actual         Estimate         Complete           11SP         Advanced Optics and Laser Space         0.000         21.323         21.107         18.296         27.505         27.982         28.011         28.875         0.000         0.000           Quantity of RDTRE Articles         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0         0			ent (ATD)			06036	05F Advanc		s  11	SP Advance		d Laser
11SP       Advanced Optics and Laser Space       0.000       21.323       21.107       18.296       27.505       27.982       28.011       28.875       0.000       0.000         Quantity of RDT&E Articles       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0 <th></th> <th>Cost (\$ in Millions)</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>Total</th>		Cost (\$ in Millions)										Total
Note:       In FY 2007, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Tech, to this project in order to more effectively manage and provide oversight of the efforts.         (U)       A. Mission Description and Budget Item Justification This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical and laser systems.         (U)       B. Accomplishments/Planned Program (\$ in Millions)       FY 2006       FY 2007       FY 2008       FY 2009         (U)       MAIOR THRUST: Develop and demonstrate advanced, long-range optical technologies such as 0.000       0.000       1.186       1.060       1.137         advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large lightweight optics; and optical coatings.       (U)       In FY 2006: Not Applicable.       10.060       1.137         (U)       In FY 2008: Begin integration of advanced optical technoplogies in an optical testbed.       (U)       11.187       2008         (U)       In FY 2009: Continue integration of testbed and begin testing of sub-systems.       0.000       5.578       4.317       3.822         (U)       MAIOR THRUST: Perform atmospheric compensation/beam control experiments for space situational on divariant of small/dim space objects, and high accuracy space object tracking.       0.000       5.578       4.317       3.822         (U) </td <td>11SP</td> <td></td> <td>0.000</td>	11SP											0.000
Note:       In FY 2007, efforts will transfer from PE 0603500F, Multidisciplinary Advanced Development Space Technology, Project 5031, Advanced Optics and Laser Space Tech, to this project in order to more effectively manage and provide oversight of the efforts.         (U)       A. Mission Description and Budget Item Justification This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical and laser systems.         (U)       B. Accomplishments/Planned Program (\$ in Millions)       FY 2006       FY 2007       FY 2008       FY 2009         (U)       MAIOR THRUST: Develop and demonstrate advanced, long-range optical technologies such as 0.000       1.186       1.060       1.137         advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large lightweight optics; and optical coatings.       (U)       In FY 2006: Not Applicable.         (U)       In FY 2008: Begin integration of advanced optical technoplogies in an optical testbed and design sub-systems such as power, advanced thermal management, signal processing, sensors, and optical mounting and vibration control.       (U)         (U)       In FY 2009: Continue integration of stabed and begin testing of sub-systems.       0.000       5.578       4.317       3.822         (U)       In FY 2007: Derform constrate detection and discrimination of small, non-resolved space objects.       0.000       5.578       4.317       3.822         (U)       In FY 2007: Demonstrate factor and		Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
<ul> <li>(U) A.Mission Description and Budget Item Justification This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical and laser systems.</li> <li>(U) B.Accomplishments/Planned Program (S in Millions) EY 2006 FY 2007 FY 2008 FY 2009 (U) MAJOR THRUST: Develop and demonstrate advanced, long-range optical technologies such as 0.000 1.186 1.060 1.137 advanced beam control: beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large lightweight optics; and optical coatings.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Perform cost trade studies and begin design of integrated testbed.</li> <li>(U) In FY 2007: Perform cost trade studies and begin testing of sub-systems.</li> <li>(U) In FY 2009: Continue integration of testbed and begin testing of sub-systems.</li> <li>(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for space situational 0.000 5.578 4.317 3.822 awareness applications using large aperture telescopes, including high-resolution satellite imaging, detection and characterization of small/dim space objects, and high accuracy space object tracking.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Demonstrate detection and discrimination of small, non-resolved space objects. Demonstrate near-infrared imaging of satellites too small or dim for present systems. Stepsin integration of high efficiency adaptive optics system for compensated visible imaging and detection of very dim space objects. Demonstrate phased array imaging for large aperture high resolution telescopes.</li> <li>(U) In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution</li> </ul>	Note:		n PE 0603500	F, Multidiscip	linary Advand	ced Developm	ent Space Tec	-	ect 5031, Adv	anced Optics	and Laser Space	ce Tech,
This project provides for the demonstration and detailed assessment of space unique technologies needed for advanced optical and laser systems.         (U)       B. Accomplishments/Planned Program (\$ in Millions)       FY 2006       FY 2007       FY 2008       FY 2009         (U)       MAIOR THRUST: Develop and demonstrate advanced, long-range optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large lightweight optics; and optical coatings.       Image (1)       Image (1)       FY 2006       FY 2007       FY 2008       FY 2009         (U)       In FY 2006: Not Applicable.       Image (1)       FY 2007: Perform cost trade studies and begin design of integrated testbed.       Image (1)       Image (1)       FY 2009: Perform cost trade studies and begin testing of sub-systems.       Image (1)       Image (1)       FY 2009: Continue integration of testbed and begin testing of sub-systems.       Image (1)       Image (1)       FY 2009: Continue integration of testbed and begin testing of sub-systems.       Image (1)       Image (1)       FY 2009: Continue integration of testbed and begin testing of sub-systems.       Image (1)       Image (1)       Image (1)       Image (1)       Image (1)       Image (2)	to this	project in order to more effectively n	nanage and pro	ovide oversigh	nt of the effort	ts.						
<ul> <li>(U) MAJOR THRUST: Develop and demonstrate advanced, long-range optical technologies such as advanced beam control; beam acquisition, tracking, and pointing; adaptive optics; dual line-of-sight pointing; large lightweight optics; and optical coatings.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Perform cost trade studies and begin design of integrated testbed.</li> <li>(U) In FY 2008: Begin integration of advanced optical technologies in an optical testbed and design sub-systems such as power, advanced thermal management, signal processing, sensors, and optical mounting and vibration control.</li> <li>(U) In FY 2009: Continue integration of testbed and begin testing of sub-systems.</li> <li>(U)</li> <li>(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for space situational avareness applications using large aperture telescopes, including high-resolution satellite imaging, detection and characterization of small/dim space objects, and high accuracy space objects. Demonstrate detection and discrimination of small, non-resolved space objects. Demonstrate phased array imaging for large aperture high resolution for very dim space objects at visible wavelengths. Perform laboratory tests to validate the performance of lightweight mirrors</li> <li>(U) In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution</li> </ul>					nt of space un	ique technolo	gies needed fo	r advanced op	tical and lase	r systems.		
<ul> <li>(U) MAJOR THRUST: Perform atmospheric compensation/beam control experiments for space situational awareness applications using large aperture telescopes, including high-resolution satellite imaging, detection and characterization of small/dim space objects, and high accuracy space object tracking.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Demonstrate detection and discrimination of small, non-resolved space objects. Demonstrate near-infrared imaging of satellites too small or dim for present systems. Begin integration of high efficiency adaptive optics system for compensated visible imaging and detection of very dim space objects. Demonstrate phased array imaging for large aperture high resolution telescopes.</li> <li>(U) In FY 2008: Continue integration of high efficiency adaptive optics system for compensated imaging and detection of very dim space objects at visible wavelengths. Perform laboratory tests to validate the performance of lightweight mirrors</li> <li>(U) In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution</li> </ul>	(U) I (U) I (U) I (U) I (U) I (U) I (U) I	MAJOR THRUST: Develop and dem advanced beam control; beam acquisit pointing; large lightweight optics; and in FY 2006: Not Applicable. in FY 2007: Perform cost trade studie in FY 2008: Begin integration of adv sub-systems such as power, advanced nounting and vibration control.	onstrate advar tion, tracking, l optical coatir es and begin d anced optical thermal mana	nced, long-ran and pointing; ngs. esign of integi technoplogies agement, signa	adaptive opti- rated testbed. in an optical l processing,	cs; dual line-o testbed and de	f-sight sign					
<ul> <li>(U) In FY 2007: Demonstrate detection and discrimination of small, non-resolved space objects. Demonstrate near-infrared imaging of satellites too small or dim for present systems. Begin integration of high efficiency adaptive optics system for compensated visible imaging and detection of very dim space objects. Demonstrate phased array imaging for large aperture high resolution telescopes.</li> <li>(U) In FY 2008: Continue integration of high efficiency adaptive optics system for compensated imaging and detection of very dim space objects at visible wavelengths. Perform laboratory tests to validate the performance of lightweight mirrors</li> <li>(U) In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution</li> </ul>	(U) 1 2 0	wareness applications using large ap letection and characterization of smal	erture telescop	bes, including	high-resolutio	on satellite ima	iging,	0.0	00	5.578	4.317	3.822
<ul> <li>and detection of very dim space objects at visible wavelengths. Perform laboratory tests to validate the performance of lightweight mirrors</li> <li>(U) In FY 2009: Integrate high efficiency adaptive optics system on large aperture high resolution</li> </ul>	(U) ] ] (U) ]	In FY 2007: Demonstrate detection a Demonstrate near-infrared imaging of of high efficiency adaptive optics syst space objects. Demonstrate phased ar	satellites too em for compe ray imaging f	small or dim f insated visible or large apertu	For present sys imaging and are high resolu	stems. Begin i detection of ve ution telescope	ery dim es.					
		and detection of very dim space objec performance of lightweight mirrors	ts at visible w	avelengths. P	erform labora	tory tests to va	alidate the					
	(U) 1	n FY 2009: Integrate high efficiency	adaptive opti	cs system on l	arge aperture	high resolutio	n					
R-1 Line Item No. 33           Project 11SP         Page-3 of 21         Exhibit R-2a (PE 0603605F)           545	Proje	ct 11SP				Page-3 of 21	3				Exhibit R-2a (Pl	E 0603605F)

		Exhibit	R-2a, RD	&E Projec	t Justifica	tion			DATE	February	2007
BUDGET ACT 03 Advanc	rivity ed Technology Develo	opment (ATD	)		0603	UMBER AND TI 3605F Advan hnology		s 1		BER AND TITLE	
telesco	complishments/Planned 1 ope. Demonstrate compen engths. Conclude phased a	sated imaging	and detection of	of very dim spa	ce objects at vi	isible	<u>FY 2</u>	<u>006 l</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) MAJC	PR THRUST: Develop and gation through severe and/	d demonstrate a	advanced optic		l technologies	for laser	0.0	000	14.559	15.730	13.337
<ul><li>(U) In FY</li><li>(U) In FY</li><li>propage</li></ul>	2006: Not Applicable. 2007: Begin integration c gation through atmospheric ve optics and tracking tech	of advanced gro c turbulence. I	und diagnostic Demonstrate an	system for ch d characterize	operation of ad						
(U) In FY propag compo	2008: Continue integratic gation through stressing at onents for sensing and way	on of advanced mospheric turb vefront control	ground diagno ulence. Perfor echnologies.	stic system for m laboratory c	characterization	on					
atmosj	2009: Complete integration of the conditions. Complete ront control technologies.					-					
(U) Total (	-						0.0	000	21.323	21.107	18.296
(U) <u>C. Oth</u>	er Program Funding Su	<u>mmary (\$ in N</u>	<u>fillions)</u>								
		<u>FY 2006</u> <u>Actual</u>	<u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> <u>Estimate</u>	FY 2010 Estimate	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	Cost to Complete	1 otal Cost
Energy	2605F, Directed Technology										
Surveil	3444F, Maui Space lance System										
Missile	3883C, Ballistic Defense Boost Phase										
coordir Reliand harmor	oject has been nated through the ce 21 process to nize efforts and ate duplication.										
Project 11SI	-			F	R-1 Line Item No					Exhibit R-2a (I	
	-				Page-4 of 21 546					Exhibit K-28 (I	

Exhibit R-2a, RDT&E I	Project Justification	DATE February 200
DGET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 11SP Advanced Optics and La Space Tech
) <u>D. Acquisition Strategy</u>		
Not Applicable.		
roject 11SP	R-1 Line Item No. 33 Page-5 of 21	Exhibit R-2a (PE 060

		Exhibit R-	2a, RDT&B	E Project .	Justificatio	on			DATE	February	2007
	ET ACTIVITY dvanced Technology Developm	ent (ATD)				IBER AND TITL 05F Advanc lology			OJECT NUMBE		chnology
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	· · · ·	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
3150	1 02	10.226	11.955	0.000	0.000	0.000	0.000	0.000		Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
(U) (U) (U) (U) (U) (U) (U) (U) (U) (U)	<ul> <li>A. Mission Description and Budget.</li> <li>This project develops advanced optica</li> <li>B. Accomplishments/Planned Prog.</li> <li>CONGRESSIONAL ADD: Satellite</li> <li>In FY 2006: Demonstrated the beam measurements for the telescope desig detector characterizations for receiver combiner.</li> <li>In FY 2007: Not Applicable.</li> <li>In FY 2008: Not Applicable.</li> <li>In FY 2009: Not Applicable.</li> <li>In FY 2006: Began development of t Continued sensing and optical design Coupled Device/Transit Instrument-II In FY 2007: Complete design and fail Prime Focus Instrument Package and Instrument-II system site determination</li> <li>In FY 2008: Not Applicable.</li> <li>In FY 2007: Complete design and fail Prime Focus Instrument Package and Instrument-II system site determination</li> <li>In FY 2009: Not Applicable.</li> <li>In FY 2008: Not Applicable.</li> <li>In FY 2008: Not Applicable.</li> <li>In FY 2009: Not Applicable.</li> </ul>	al technologies ram (\$ in Mill Active Imagin rotator, a key n; demonstrate r development; th Space Surve he Visible Inte work as well a I system. Com bricate the Wid the Tracker. ( on and fabricat ions of LIDAF sional capabili	for various st ions) g National Te transmitter con- ed and characte and analyzed eillance Initiat grated-field R as structural an tinued design of de Field Corre Complete Char e of the lens a R to Vehicles y ty for imaging	stbed Program mponent; perf erized a 50 wa initial results ive (NESSI). eplicable Uni d optical refu of the focal pl ctor. Conduc rge Coupled I nd dome.	n. Formed piston att fiber laser; for a 22-chan t Spectrograph urbishment for ane mosaic. t design studie Device/Transit (ALVA). small/dim targ	jitter performed nel beam n. the Charge es for the	ons. <u>FY 20</u> 1.0 1.7 5.7	61	<u>Y 2007</u> 0.000 1.594 6.775	FY 2008 0.000 0.000	<u>FY 2009</u> 0.000 0.000
	Designed and built a sensor for first k awareness and missile tracking applic high-accuracy metrics. Demonstrated identification missions, microsat track	cations. Demo l the improved	nstrated precis	sion satellite h r deep space r fense discrimi R-1	andover capal netric and spa nation. Invest Line Item No. 3	bility using ce object tigated					
Proje	ect 3150				Page-6 of 21 548					Exhibit R-2a (P	E 0603605F)

	Exhibit R-2a, RDT&E Projec	t Justification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advance Technology			IBER AND TITLE ced Optics Te	echnology
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> eye-safe laser radars and showed increased battlefield information in combat damage assessment, and camouflage penetration. Integrated laser radar and airborne turret ball for transition to the warfighter.		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	In FY 2007: Develop airborne night-time imaging for counter-improvised ex- operational intelligence and targeting. Integrate, flight test, and evaluate mil- nighttime video. Develop low-power photon-counting laser radar for small a characterization, and imaging. Develop high-speed ranging and radiometry of In FY 2008: Not Applicable.	litary utility lasers for and/or dim object tracking,				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrate		1.640	0.996	0.000	0.000
(U)	In FY 2006: Completed wavefront measurement preparations. Obtained aer measurement hardware; began preparations for use of software and hardware integration of Hemispherical Optical Sensing and Tracking system.	-				
	In FY 2007: Demonstrate self-contained capability to optically acquire and the defense system (MANPADS) missiles. Provide testbed and risk reduction can force protection applications. Measure and analyze aircraft platform vibration integration of high-energy laser weapons.	apabilities at low power for				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)	CONCRESSIONAL ADD. D. 1 (' O. (' 10'llow A. I'		0.000	1.504	0.000	0.000
(U) (U)	CONGRESSIONAL ADD: Real-time Optical Surveillance Applications. In FY 2006: Not Applicable.		0.000	1.594	0.000	0.000
(U)	In FY 2007: Conduct Congressionally-directed effort for Real-time Optical	Surveillance Applications				
(U)	In FY 2008: Not Applicable.	Sur termanee i Apprications.				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Hyper/multispectral Data Reduction and Archiv	ving (HyDRA) Project.	0.000	0.996	0.000	0.000
· /	In FY 2006: Not Applicable.					
	In FY 2007: Conduct Congressionally-directed effort for the HyDRA Project In FY 2008: Not Applicable.	ct.				
	ject 3150	R-1 Line Item No. 33 Page-7 of 21			Exhibit R-2a (F	

Exhibit F	R-2a, RD1	C&E Projec	t Justifica	tion			DATE	February	2007
UDGET ACTIVITY 3 Advanced Technology Development (ATD)			0603	UMBER AND TIT 8605F Advan nnology	rLE ced Weapon		ROJECT NUMBI	ER AND TITLE	
<ul> <li>U) <u>B. Accomplishments/Planned Program (\$ in M</u></li> <li>U) In FY 2009: Not Applicable.</li> <li>U) Total Cost</li> </ul>	<u>(illions)</u>				<u>FY 20</u> 10.2		FY 2007 11.955	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
					10.2	.20	11.933	0.000	0.000
	<u>FY 2007</u> Estimate	<u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	<u>FY 2010</u> Estimate	FY 2011 Estimate	<u>FY 2012</u> <u>Estimate</u>	FY 2013 Estimate	Cost to Complete	LODAL COSE
<ul> <li>Surveillance Systems.</li> <li>J) PE 0602605F, Directed Energy Technology.</li> <li>J) This project has been</li> </ul>									
coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.									
J) <b><u>D. Acquisition Strategy</u></b> Not Applicable.									
Project 3150		F	R-1 Line Item No Page-8 of 21	. 33				Exhibit R-2a (I	PE 0603605
		-	550						

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	BET ACTIVITY dvanced Technology Developm	ent (ATD)			06036	IBER AND TITL 05F Advanc lology		s 31	OJECT NUMBE 51 High Pov chnology		ate Laser
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
3151	High Power Solid State Laser Technology	Actual 13.240	Estimate 26.650	Estimate 12.388	Estimate 11.428	Estimate 21.669	Estimate 16.932	Estimate 23.569	Estimate 32.552	Complete Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
	A. Mission Description and Budget This project provides for the develop aircraft protection, force protection, for demonstrated include: (1) compact, re control components to effectively com- meet key system concept performance concept assessments to include vulner system concepts and identify issues re	nent, integration orce application eliable, and affer npensate and p e parameters, re rability assessme	on, demonstrat n, precision er ordable laser d ropagate laser eliability, affo nents and targ	ngagement, an levices with g radiation thro rdability, and et effect testin	d Global War ood beam qua ough the atmos packaging rec ag. Identify ca	on Terrorism lity and scalab sphere to a targ quirements uni ritical design of	missions. Cri pility to high p get. Emphasis que to potenti lata for laser s	tical technolo ower; (2) adves s will be on de al applications ystem concep	gies developed anced optics a monstrating th s. Perform las ts. Develop h	d and nd laser beam he ability to her system igh energy las	ı ser
	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Develop, integra laser technology for scalable, high en applications and ground-based laser s	te, and demon ergy laser devi	strate solid sta ices for inserti			•	<u>FY 20</u> 3.0		<u>7 2007</u> 3.789	<u>FY 2008</u> 1.022	<u>FY 2009</u> 0.315
	In FY 2006: Benchmarked technolog size, weight, efficiency, affordability, acceptability (air, land, and maritime) development of a solid state laser that detect, track, and classify tactical targ tactical platform to defeat next general capability of handling a sensor-killer search functions. In FY 2007: Continue scaling solid s	gies in an effor , reliability, ma ), and ruggedno t is scalable to gets. Began de ation air-to-air laser, while re	t to obtain arch aintainability, a ess for tactical the weapons- velopment of threats. Deve taining all of the n a goal of read	supportability weapon appl class level. En a laser for even loped a beam the infrared co ching weapon	, environment ications. Bega nhanced laser entual use on a director that h puntermeasure s-class power,	al an sources to n airborne has the s and , beam					
	quality, run time, etc. levels. Complete platform. Investigate integrating the advanced thermal management system successful transition. Continue invest through field experiments and custom	laser technolog ms, avionics, so igating tactical	gy with tactica ensors, and fir l laser applicat	l platform sub e control to in	o-systems such acrease the pot	n as power, ential for					
(U)	In FY 2008: Scale solid state lasers for	or tactical weap	pons and defer	nse, with a goa	al of exceeding	g the					
Proi	ect 3151			R-1	Line Item No. 3 Page-9 of 21	3				Exhibit R-2a (F	PE 0603605F)
					551						/

	Exhibit R-2a, RDT&E Projec	ct Justification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Technology	l Weapons		BER AND TITLE Yower Solid St	ate Laser
	<b>B.</b> Accomplishments/Planned Program (\$ in Millions) thresholds for weapons-class power, beam quality, and run time capabilities. and weight, as well as increase in efficiency, affordability, reliability, mainta operational environmental acceptability, and ruggedness. Continue integrati tactical platform sub-systems such as power, advanced thermal management and fire control to increase the potential for successful transition. Test overa device-level performance and work issues based on the integration of the eje increased mass flow singlet-oxygen generators, and advanced fuels into a lass In FY 2009: Build and evaluate solid state lasers for tactical weapons and de thresholds for weapons-class power, beam quality, and run time capabilities. reducing size and weight, as well as increasing efficiency, affordability, reli- supportability, operational environmental acceptability, and ruggedness. Fun- technology with tactical platform sub-systems such as power, advanced therr avionics, sensors, and fire control to increase the potential for successful tran- evaluate overall chemical laser device-level performance and issues based on improved ejector nozzle concepts, increased mass flow singlet-oxygen gener into a laser device.	ainability, supportability, ng laser technology with systems, avionics, sensors, all chemical laser ector nozzle concepts, ser device. efense that exceed the . Continue to focus on ability, maintainability, rther integrate laser mal management systems, nsition. Continue to n the integration of	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	MAJOR THRUST: Develop, integrate, and demonstrate advanced optical an advanced systems concepts. Technologies include optical components, optic control, atmospheric compensation, and pointing and tracking. Develop and and perform advanced critical experiments integrating laser and beam control In FY 2006: Prepared lasers and their gimbals for day-night electro-optical t advanced technology demonstration. Perform assessments to determine lase for integrated high energy laser.	cal coatings, advanced beam analyze system concepts of technologies. tracker countermeasures	2.506	11.464	11.366	11.113
	In FY 2007: Begin integration experiments to focus on architectures favoral efficiency, affordability, reliability, maintainability, supportability, operation acceptability, and ruggedness for tactical weapon applications. Begin facility modifications for integrated high energy laser. In FY 2008: Begin acquisition of a solid state laser to meet program specific energy laser testbed. Begin to upgrade existing facilities, integrate device an checkout. Demonstrate advanced tactical beam control hardware component	nal environmental y and support equipment cations for integrated high nd conduct initial testbed				
D	ject 3151	R-1 Line Item No. 33 Page-10 of 21			Exhibit R-2a (I	

	Exhibit R-2a, RDT&E Proje	ect Justification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advance Technology			ABER AND TITLE	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Analyze advanced beam control concepts in integrated simulations. In FY 2009: Continue integrated high energy laser component acquisition evaluate testbed performance objectives against multiple applications. Init upgrades. Integrate advanced tactical beam control hardware components performance predictions. Enhance advanced beam control system concepts system requirements.	iate next spiral of system in the laboratory and validate				
(U)	CONCRESSIONAL ADD. Low Second Alignment System		2 250	0.000	0.000	0.000
(U) (U)	CONGRESSIONAL ADD: Low Speed Airspeed System. In FY 2006: Conducted Congressionally-directed effort for Low Speed Ai	rspeed System.	3.352	0.000	0.000	0.000
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)			4			
(U)	CONGRESSIONAL ADD: Wafer Integrated Semiconductor Laser. In FY 2006: Continued toward the goal of lower cost/watt for solid state la and processing to increase yield and thus cut costs, and by enhancing device improve reliability. In FY 2007: Not Applicable.		1.929	0.000	0.000	0.000
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable					
(U) (U)	CONGRESSIONAL ADD: High Brightness Laser Diode Source for Fiber In FY 2006: Focused on further development of wavelength stabilization t fiber-coupling packaging concepts, and refinement of manufacturing proce lower cost.	echniques, improved	2.411	0.000	0.000	0.000
	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Mid-Infrared Semiconductor Laser Technolog In FY 2006: Not Applicable.	y.	0.000	1.656	0.000	0.000
Pro	ject 3151	R-1 Line Item No. 33 Page-11 of 21			Exhibit R-2a (	PE 0603605E)

	Exhibi	t R-2a, RD	T&E Projec	t Justifica	tion			DATE	February	2007
BUDGET ACTIVITY <b>33 Advanced Techno</b> l	ogy Development (ATD	))		0603	UMBER AND TI 3605F Advan hnology	⊺LE ced Weapon	s 3	ROJECT NUMB 151 High Po echnology		tate Laser
U) <u>B. Accomplishmer</u>	ts/Planned Program (\$ in	Millions)				<u>FY 20</u>	<u>)06</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2007: Condu	ct Congressionally-directed	d effort for Mic	l-Infrared Sem	iconductor Las	er					
Technology.										
(U) In FY 2008: Not A										
(U) In FY 2009: Not A	oplicable.									
(U)										
	ADD: High Energy Lase	r- Directed End	ergy Weapon (	HEL-DEW) So	caling	0.0	000	2.338	0.000	0.000
Optimization.										
(U) In FY 2006: Not A	-	1 00 0 11								
	ct Congressionally-directed	d effort for HE	L-DEW Scalin	g Optimization	1.					
(U) In FY 2008: Not A										
(U) In FY 2009: Not A	oplicable.									
(U) (U) CONGRESSIONA	ADD: Advanced Weene	ns and Lasar D	ioda Davalonn	aant		0.0	000	2.533	0.000	0.000
(U) In FY 2006: Not A	ADD: Advanced Weapon	lis and Laser D	loue Developii	lent.		0.0	)00	2.333	0.000	0.000
	ct Congressionally-directed	d effort for Adv	vanced Weanou	ns and Laser D	iode					
Development.	et congressionariy-directed	a chort for Au	aneed weapon		loue					
(U) In FY 2008: Not A	oplicable.									
(U) In FY 2009: Not A										
(U)	I									
	ADD: Lightweight Multi	i-purpose Lase	ſ.			0.0	000	4.870	0.000	0.000
(U) In FY 2006: Not A		1 1								
U) In FY 2007: Condu	ct Congressionally-directed	d effort for Lig	htweight Multi	-purpose Laser	r.					
(U) In FY 2008: Not A	oplicable.									
(U) In FY 2009: Not A	oplicable.									
(U) Total Cost						13.2	240	26.650	12.388	11.428
U) C. Other Program	Funding Summary (\$ in N	(Aillions)								
	<u>FY 2006</u>	<u>FY 2007</u>	FY 2008	FY 2009	FY 2010	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	
	<u>Actual</u>	Estimate	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>		<u>Complete</u>	Total Cost
(U) Related Activities:	<u>r tottan</u>	<u>Lound</u>	Lound	Lound	<u>Loundry</u>	Lound	<u>Lotinute</u>	<u>Lotinute</u>	<u>complet</u>	E
(U) PE 0602102F, Mate	ials.									
(U) PE 0603270F, Elect										
				R-1 Line Item No	. 33					

Exhibit R-2a, RDT&E P	roject Justification	DATE February 2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3151 High Power Solid State Lase Technology
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
Combat Technology.		
(U) PE 0602605F, Directed		
Energy Technology.		
(U) PE 0601108F, High Energy		
Laser Research Initiatives.		
(U) PE 0602890F, High Energy		
Laser Research.		
(U) PE 0603924F, High Energy		
Laser Advanced Technology		
Program.		
(U) PE 0602120A, Sensors and		
Electronic Survivability.		
(U) PE 0602307A, Advanced		
Weapons Technology.		
(U) PE 0602624A, Weapons and		
Munitions Technology.		
(U) PE 0603004A, Weapons and		
Munitions Advanced		
Technology.		
(U) PE 0602114N, Power		
Projection Applied Research.		
(U) PE 0603175C, Ballistic		
Missile Defense Technology		
(U) PE 0605799D8Z, Force		
Transformation		
(U) PE 0603941D8Z, Test and		
Evaluation/Science and		
Technology		
(U) This project has been		
coordinated through the		
Reliance 21 process to		
	R-1 Line Item No. 33	
Project 3151	Page-13 of 21	Exhibit R-2a (PE 0603605

Exhibit R-2a, RDT&E P	DATE February 2007	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 3151 High Power Solid State Laser Technology
<ul> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> harmonize efforts and eliminate duplication.</li> <li>(U) The technology efforts in this PE that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>		
Project 3151	R-1 Line Item No. 33 Page-14 of 21 556	Exhibit R-2a (PE 0603605F)

		Exhibit R-	2a, RDT&I	E Project .	Justificatio	on			DATE	February	2007
	GET ACTIVITY Advanced Technology Developmo	ent (ATD)				IBER AND TITL 05F Advanc lology		s 31	OJECT NUMBE 52 High Pov chnology		ave
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	High Power Microwave	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
3152	2 Technology	10.170	12.890	10.504	9.153	23.635	12.513	13.342	14.846	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		
(U)	<b>A. Mission Description and Budget</b> This project develops high power mic disruption, degradation, damage, or de and communication systems, as well a collateral structural or human damage lethality data base to identify potentia decisions. Representative U.S. and for small frequency range) technologies a	rowave (HPM estruction of an as large and sm . In addition, a l vulnerabilitie reign assets ar	) generation an n adversary's e nall air defense millimeter wa s of U.S. syste e tested to unc	electronic infra- e and comman ve force prote ems to HPM t	astructure and ad and control ction technolo hreats and to p	military capal systems. In n ogies are devel provide a basis	bility. These t nany cases, thi oped. It also for future off	argeted capab s effect can be develops a su ensive and de	ilities include e generated co sceptibility, vi fensive weapo	local comput overtly with no ulnerability, a on system	er o nd
(U) (U) (U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Conduct effects of susceptibility predictions. Investigate to higher Air Force priorities this thru In FY 2006: Began transitioning HPI Air Force Standard Analysis Toolkit a tests to improve HPM system design infrastructure to HPM attack. In FY 2007: Continue high power mi Model real targets and predict probab frequency airfield defense against sm mitigate vulnerabilities of U.S. infrast interference/electromagnetic compati	experimentation and develop t ist is being tem M engagement and to addition and lethality. icrowave effec ility of kill for all surface-to-a tructure to HPI	on to expand as echnologies for porarily termi- lethality mod- al users. Exec Identified and ts tests to imp- various HPM air missile atta M attack. Invo	or HPM airfie nated in FY 2 eling and simu- cuted high por mitigated vul rove HPM sys scenarios, inc ck. Identify a estigate electro	eld defense. N 2009. ulation capabi wer microwav nerabilities of stem design ar cluding HPM/ and develop te omagnetic	lote: Due lity into e effects TU.S. nd lethality. radio	<u>FY 20</u> 0.7		<u>7 2007</u> 0.948	<u>FY 2008</u> 0.594	<u>FY 2009</u> 0.000
	In FY 2008: Refine airfield defense t In FY 2009: Not Applicable. MAJOR THRUST: Develop and eva anti-personnel weapon applications su In FY 2006: Completed support of us	luate millimete	er-wave active force protection	e denial techno on from a stan	ologies for nor d off aircraft.		4.2	37	5.886	3.768	4.626
Pro	ject 3152				Line Item No. 3 Page-15 of 21 557	3				Exhibit R-2a (F	PE 0603605F)

	Exhibit R-2a, RDT&E Project Ju	stification		DATE	February	2007
	OGET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advance Technology			ABER AND TITLE	ave
(U)	development spiral product. Developed and evaluated technologies for non-lethal		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Continued the development of high power millimeter-wave source for airborne ap computational physics simulations of millimeter-wave sources against the draft de					
	for the coaxial source approach. Performed cold testing for conventional source h	-				
	progression towards final source assembly. Provided technical expertise and back organizations tailoring Active Denial concepts and capabilities to their needs and g airborne applications.	-				
(U)	In FY 2007: Develop and evaluate technologies for non-lethal weapons application development of high power millimeter-wave source for airborne applications. Evaluate technologies for airborne applications.	aluate first phase				
	conventional source approach. Identify deficiencies and evaluate need to rebuild. design review for coaxial source design or proceed on coaxial insert risk reduction	-				
	approach. Begin hardware development for full power source test stand including contract. Provide technical expertise and background to external organizations tai concepts and capabilities to their needs and glean data relevant to airborne applica	award of test stand loring Active Denial				
(U)						
	Continue the development of high power millimeter-wave source for airborne app					
	rebuild and manufacturer test of the second version of the conventional gyrotron a of the first coaxial design gyrotron. Continue with hardware development, procur					
	and testing for the full power source test stand. Provide technical expertise and ba	ckground to external				
	organizations tailoring Active Denial concepts and capabilities to their needs and g airborne applications.	glean data relevant to				
(U)	In FY 2009: Continue to develop and evaluate technologies for non-lethal weapon					
	Downselect from conventional or coaxial approaches arriving at best high power r source hardware. Complete the development of millimeter-wave source for airbor					
	ground-based demonstration form. Complete hardware development, procuremen					
	testing for the full power source test stand. Begin design and development of airb	orne antenna				
	demonstration hardware to include beam control. Provide technical expertise and external organizations tailoring Active Denial concepts and capabilities to their ne	•				
	relevant to airborne applications.	eus und greun dutu				
(U)			<b>5</b> 10 c	6 0 <b>5</b> 6	6.1.10	4 507
(U)	MAJOR THRUST: Develop the technology to integrate HPM devices on various	platforms, to include	5.196	6.056	6.142	4.527
Pro		ne Item No. 33 ge-16 of 21			Exhibit R-2a (I	PE 0603605F)
		558				,,

	Exhibit R-2a, RDT&E Project Ju	stification		DAT	February	2007	
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Technology	Weapons		CT NUMBER AND TITLE ligh Power Microwave ology		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	aerial, and investigate specific target sets of interest. Develop and demonstrate HI disrupt, degrade, damage, or destroy an adversary's electronic systems. In FY 2006: Proceeded with maturation and miniaturization efforts of HPM subsystems.						
	both electronic attack and counter improvised explosive device applications. Come experiments that include investigating electromagnetic interference issues. Exami- the HPM source, antenna, and pulse power to increase functionality. Began integr HPM subsystem components in preparation for stand-alone field demonstration. If subsystems to ensure required energy levels are produced. Investigated optimal co- permanent magnets in relativistic magnetron, and fabricated source. Integrated the a command and control device to demonstrate operation at threshold operating part defining hardening requirements of representative pallet against HPM subsystem pelectromagnetic interference/coupling. Integrated a repetitively pulsed gigawatt-c antenna that will be installed into an airborne platform. Conducted integration exp investigating electromagnetic interference issues. Examined the interactions of the antenna, and pulse power to increase functionality.	ned the interactions of ation efforts of all Refined HPM onfiguration for e HPM subsystem with ameters. Began oredicted lass HPM source and periments that include					
(U)	In FY 2007: Continue miniaturization, integration and ruggedization of HPM test experimentation. Examine the interactions of the HPM source, antenna, and pulse functionality. Investigate enhanced configuration for permanent magnets in relative fabricate source. Begin fabrication of subcomponents as determined. Continue in HPM testbed testing and diagnostics on hardware for efficiency and to determine a electromagnetic interference/coupling issues. Improve HPM testbed command an Demonstrate the performance of the integrated gigawatt-class HPM source and an HPM system interaction with the airborne platform. Perform system diagnostics of experiment to ensure proper source operation.	power to increase vistic magnetron, and tegration and begin any potential d control sub-systems. tenna. Investigate on integrated					
(U)	testing and diagnostics on hardware developed and integrated in FY 2007 for effic determine any potential electromagnetic interference/coupling issues. Improve HI and control systems for pulsed operation greater than threshold levels. Continue for subcomponents as determined by FY 2007 risk reduction exercise.	iency and to PM testbed command abrication of					
(U)	In FY 2009: Conduct laboratory demonstration of the miniaturized and ruggedize Begin fabrication of electromagnetic interference protection system. Implement th						
Pro		e Item No. 33 ie-17 of 21 559			Exhibit R-2a (	PE 0603605F)	

		Fxhihif	R-2a RD		t Justifica				DATE			
	GET ACTIVITY Advanced Technology Deve				PE N <b>060</b> 3	UMBER AND TI	TLE ced Weapon		February 2007 PROJECT NUMBER AND TITLE 3152 High Power Microwave Technology			
(U)	<b>B. Accomplishments/Planned</b> testbed command and control s subcomponents as determined	systems for pulse	d operation gro		shold levels. In	nplement	<u>FY 20</u>	)06	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)							10.1	170	12.890	10.504	9.153	
(U) (U) (U) (U)	C. Other Program Funding S Related Activities: PE 0602202F, Human Systems Technology. PE 0602605F, Directed Energy Technology. PE 0603851M, Nonlethal Weapons - Demonstration/Validation. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	<u>ummary (\$ in M</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions)</u> <u>FY 2007</u> <u>Estimate</u>	FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> Estimat		Cost to Complete	LOTAL COST	
(U)	<b>D. Acquisition Strategy</b> Not Applicable.											
Pro	ject 3152			l	R-1 Line Item No Page-18 of 2 560					Exhibit R-2a (F	PE 0603605F)	
				ι	JNCLASSIF	IED						

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007
	ET ACTIVITY dvanced Technology Developme	ent (ATD)			06036	MBER AND TITL 05F Advanc 10logy			COJECT NUMBE		echnology
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
2647		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
3647	High Energy Laser Technology Quantity of RDT&E Articles	8.488	3.915	0.000	0.000	0.000	0.000	0.000		Continuing	TBD
Note	Funds for the FY 2006 Congressiona		Ŷ	Ŷ		ů	Ŷ				l
	nology, from PE 0603500F, Multi-Dis										
]	This project provides for the developm Near-term focus is on airborne high en applications. Critical technologies de propagate laser radiation through the a key technology in most long-range hig vulnerability are developed.	nergy laser mis veloped and de atmosphere to	ssions, althoug emonstrated ir a target. Corr	gh the technol clude advanc ecting the lase	ogy developed ed high energy er beam for dis	d for this proje y laser devices stortions induc	ct is directly a and laser bea ed by propaga	pplicable to r m control to e ation through	nost high ener efficiently com the turbulent a	gy laser pensate and atmosphere is	the
(U)	<b>B. Accomplishments/Planned Prog</b>	<u>am (\$ in Mill</u>	<u>ions)</u>				<u>FY 20</u>	<u>06 F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop and den		•••	-	•••		1.5	42	1.967	0.000	0.000
(U)	with improved efficiency for insertion In FY 2006: Identified overall device iodine generation and ejector nozzle of closed-cycle chemical approaches for improve device performance. Began Tested deuterated fuels and determine flowloop development and testing for for reduced logistics tail for chemical	e-level perform concept into a use on tactica work to extend d performance tactical platfo oxygen iodine	hance and issu laser device. I l airborne plat d the range of e increases. P rms. Tested a e lasers.	es based on the Performed fie forms. Used high power at erformed basis and evaluated	he integration of Id demonstrati deuterated che irborne chemic ic hydrogen pe fuels regenera	of the ions of emicals to cal lasers. eroxide tion system					
	In FY 2007: Test overall device-leve nozzle concepts and increased mass fi fuels and determine performance incr oxygen iodine laser systems.	low singlet-ox	ygen generato	rs into a laser	device. Test	advanced					
	In FY 2008: Not Applicable.										
(U) (U)	In FY 2009: Not Applicable.										
	CONGRESSIONAL ADD: Aerospa	e Relav Mirro	or System				2.0	26	0.000	0.000	0.000
. ,	In FY 2006: Developed preliminary	•	•	r redirection o	ptical systems	s. Software	2.0		0.000	0.000	0.000
	ect 3647			R-1	Line Item No. 3 Page-19 of 21 561					Exhibit R-2a (P	'E 0603605F)

Exh	ibit R-2a, RD	T&E Projec	ct Justifica	tion			DATE	February	2007
BUDGET ACTIVITY 03 Advanced Technology Development (/	ATD)		060	UMBER AND TI 3605F Advan hnology	TLE Iced Weapon		PROJECT NUMB	ER AND TITLE	
(U) <u>B. Accomplishments/Planned Program (</u>					<u>FY 20</u>	<u>)06</u>	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
<ul><li>and optical hardware designs were matured models of optical and mechanical componed mirror payload element.</li><li>(U) In FY 2007: Not Applicable.</li></ul>									
(U) In FY 2008: Not Applicable.									
(U) In FY 2009: Not Applicable.									
(U)									
(U) CONGRESSIONAL ADD: Laser Spark C	ountermeasure Pro	ogram.			4.9	920	1.948	0.000	0.000
(U) In FY 2006: Investigated Laser Spark miss	ile infrared counter	ermeasure tech	nology and den	nonstrate the					
infrared countermeasures effectiveness of t	he multiple interna	al laser effects	associated with	l					
plasma/sparks. Performed countermeasure									
brassboard countermeasure laser system. I		-		•					
dynamics under countermeasure operation	and determined ef	fectiveness. Su	arveyed platfor	m footprints					
available and perform packaging design.			1 1:00	• .1					
(U) In FY 2007: Perform laboratory effects test damage threshold of different focal plane a study for selected operational scenarios.	-								
(U) In FY 2008: Not Applicable.									
(U) In FY 2009: Not Applicable.									
(U) Total Cost					8.4	188	3.915	0.000	0.000
	• • • • • • • • • • • • • • • • • • • •								
(U) <u>C. Other Program Funding Summary (\$</u>		EV 2009	EX 2000	EV 2010	EV 2011	EV 2012	EV 2012	Contra	
<u>FY 200</u>		<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimata	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u>	Total Cost
(U) Related Activities:	ai <u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	2
(U) PE 0602605F, Directed									
Energy Technology.									
(U) PE 0603883C, Ballistic									
Missile Defense Boost Phase									
Segment.									
(U) This project has been									
coordinated through the									
Project 3647			R-1 Line Item No Page-20 of 2'					Exhibit R-2a (	DE 0603605E)
			562	1					L 0003003F)

Exhibit R-2a, RDT&E Pro	oject Justification	DATE	.7
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	February 200 PROJECT NUMBER AND TITLE 3647 High Energy Laser Tech	
<ul> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) The technology efforts in this PE that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser</li> </ul>			
program office. (U) <u>D. Acquisition Strategy</u> Not Applicable.			
Project 3647	R-1 Line Item No. 33 Page-21 of 21 563	Exhibit R-2a (PE 060	03605F

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#### PE NUMBER: 0603789F PE TITLE: C3I Advanced Development

	Ex	DATE	February 2007									
	UDGET ACTIVITY PE NUMBER AND TITLE 3 Advanced Technology Development (ATD) 0603789F C3I Advanced Development											
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
	Total Program Element (PE) Cost	41.345	48.195	27.357	32.050	45.933	41.043	49.550	58.495		TBD	
4072	Dominant Battlespace Awareness	10.916	18.881	6.037	6.981	9.948	9.281	10.657	12.739	Continuing	TBD	
4216	Battlespace Information Exchange	15.796	12.490	8.012	11.376	17.565	14.506	19.740	24.988	Continuing	TBD	
4872	Aerospace Information Dominance	14.633	16.824	13.308	13.693	18.420	17.256	19.153	20.768	Continuing	TBD	

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

This program develops and demonstrates Air Force Command, Control, Communications, and Intelligence (C3I) technologies for the warfighter. The technologies address the ability to support the global information exchange of correlated and fused information to ensure the Air Force can plan and execute missions in a dynamic, complex environment. The Dominant Battlespace Awareness project will provide affordable operational data capabilities for personnel to understand militarily relevant situations, on a consistent basis, with the precision and timeliness needed to accomplish the mission. The Battlespace Information Exchange project will develop reliable, secure, jam-resistant, inter-operable worldwide global information enterprise capabilities, providing the Air Force assured communications and reach-back capability in a distributed operational environment. It will also demonstrate offensive cyber operations technologies allowing attack and exploitation of adversary information systems by the Air Force. The Aerospace Information Dominance project provides the technology and demonstrations needed to allow the warfighter to plan, assess, execute, monitor, and re-plan on the compressed time scales required for tomorrow's conflicts, whether in combat or peacekeeping missions. Note: In FY 2007, Congress added \$1.0 million for Advanced Course in Engineering, \$4.8 million for Advanced Fusion for Urban Operations for Forensic Anticipation of Insurgent Activity (Note: Only to expend the recently demonstrated Intelligence Fusion System to provide dynamic situational awareness of insurgent activities as precursors to critical events), \$1.0M for Hybrid Radio Frequency/Optical Communications Terminal, \$2.0 million for Massively Parallel Optical Interconnects for Battlespace Information Exchange, \$1.0 million for National Center for Multi-Source Information Fusion Fusion for Programs. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing upgrades and/

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Exhibit R-2, RDT&E Bu	DATE Februar	DATE February 2007					
BUDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced D	PE NUMBER AND TITLE 0603789F C3I Advanced Development					
U) <u>B. Program Change Summary (\$ in Millions)</u>							
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
U) Previous President's Budget	41.124	37.785	31.161	38.298			
U) Current PBR/President's Budget	41.345	48.195	27.357	32.050			
U) Total Adjustments	0.221						
U) Congressional Program Reductions		-0.007					
Congressional Rescissions	-0.033	-0.183					
Congressional Increases		11.600					
Reprogrammings	1.240	1.000					
SBIR/STTR Transfer	-0.986						
U) <u>Significant Program Changes:</u> Not Applicable.							
C. Performance Metrics							
(U) Under Development.							
	R-1 Line Item No. 34						
	Page-2 of 22 566		Exhibit R-2	2 (PE 0603789F			

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007	
	ET ACTIVITY dvanced Technology Developme	ent (ATD)			06037	/BER AND TITL 89F C3I Adv opment		40	OJECT NUMBE 72 Dominan vareness	R AND TITLE	e	
	Cost (\$ in Millions)	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total							
4072									12.739	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0			
(U)	<b>B. Accomplishments/Planned Progr</b> MAJOR THRUST: Develop and dem detection, tracking, identification, and technologies for situational awareness In FY 2006: Developed a baseline cap	onstrate advar l targeting of ti s.	ced signal and me-critical ta	rgets, and info	ormation extra	ction	<u>FY 20</u> 1.6		<u>¥ 2007</u> 2.732	<u>FY 2008</u> 1.988	<u>FY 2009</u> 2.152	
(U)	Intelligence (HUMINT) reports and c sources. Developed and assessed the a In FY 2007: Demonstrate a baseline c reports and correlate and fuse the info prototype that is able to extract inform real-time Signal Processing and Geole by military and asymmetrical threats. processing.	ability to extra apability to peo- ormation with in nation from vo ocation capabi	ct information rform advance nformation fro luminous text lity for emergi	from volumi ed text exploi om other sour ual data. Initia	nous textual d tation of HUM ces. Demonstr ate developme al communica	ata. IINT rate ent of a tions used						
	In FY 2008: Continue development or emerging commercial communication development of airborne-cued, ground	is used by mili	tary and asym	-	-	ity for						
	In FY 2009: Demonstrate a real-time commercial communications used by ground-based signal processing	Signal Proces	sing and Geol	-								
(U)												
Proj	ect 4072				Line Item No. 3 Page-3 of 22	4				Exhibit R-2a (P	E 0603789F)	
					567							

Exhibit R-2a, RDT&E Project Justification February 2007						
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)		PE NUMBER AND TITLE 0603789F C3I Advanced Development		PROJECT NUMBER AND TITLE 4072 Dominant Battlespace Awareness		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced data handling, event visualization techn fusion to enable a more effective utilization of the vast amounts of data ava to provide optimized situation awareness, as well as to support all phases of This effort includes \$1.0 million in FY 2006 Congressional Add funding, a Congressional Add funding.	ilable to intelligence analysts f combat operations. Note:	4.964	9.808	4.049	4.829
(U)		ort the warfighter. Developed omains on a single screen oped and demonstrated cused techniques to evaluate onitor, assess, and predict ence accrual techniques for				
(U)		omated process to visualize vide an optimal means of d tracking to monitor, assess, trate operator-focused d collaboration of information of adversarial behavior l tracking, multible al reasoning and cued intelligence data with . Conduct for Forensic Anticipation of				
(U)						
i		R-1 Line Item No. 34				

	Exhibit R-2a, RDT&E Project	Justification		DATE	February	2007	
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advan Development	ced		CT NUMBER AND TITLE Dominant Battlespace eness		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> tracking, multi-INT association and cross-cueing and geospatial reasoning and Continue to develop methods for combining post-event processing of intelligent streaming intelligence data for indications and warning functions. Initiate the of of a synthetic assessment environment for the evaluation of the full range of fu- include basic correlation algorithms to higher levels of fusion algorithms tested command and control systems. Initiate investigation of Fusion of Cyber Intelli- traditional INTs.	nce data with real-time lesign and development sion technologies to l in conjunction with	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	In FY 2009: Demonstrate software and algorithmic design and development eff adversarial behavior within persistent surveillance data, contextual tracking, tar tracking, multi-INT association and cross-cueing and geospatial reasoning and Demonstrate methods for combining post-event processing of Intel data with re data for indications and warning functions. Continue design and development environment for the evaluation of the full range of fusion technologies to inclue algorithms to higher levels of fusion algorithms tested in conjunction with C2 s investigation of Fusion of CYBINT with traditional INTs.	rget-feature-aided cued exploitation. eal time streaming Intel of a synthetic assessment de basic correlation					
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advant fusion capabilities to support multi-source capabilities, new sensor types, cognit automated fusion process management. Note: This effort contains \$2.8 million Congressional Add funding, and \$1.0M in FY 2007 Congressional Add funding this thrust move to Project 4216 in this PE.	itive models, and n in FY 2006	4.337	4.541	0.000	0.000	
	In FY 2006: Developed initial inter operable exploitation technologies for real- Enhanced ISR resource management development through incorporation of inf network centric operations. Developed tools for mission/task-based priority and utilization of assets and fusion-focused ISR tasking, and explored the synergy b Performed a multi-platform interoperability and limited tracking demonstration resource management, information management, and communications manage Conducted Congressionally-directed effort for Net-Centric Dissimilar Data Fus In FY 2007: Continue development of interoperable exploitation and data link ISR management, which incorporates non-traditional ISR into the management track, target, engage, and access. Perform a multi-platform tracking demonstration	Formation sharing and d quality of service between the two. a effort for integration of ment capabilities. sion Program. technologies for real-time t algorithms for find, fix,					
	R-1	Line Item No. 34					

Exhibit R-2a, RDT&E Project Ju	stification		DATE	February	2007		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TI 0603789F C3I Ac Development			PROJECT NUMBER AND TITLE 4072 Dominant Battlespace			
<ul> <li>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> assets against a variety of advanced military and asymmetric threat scenarios. De capability to dynamically task sensors and assure timely, prioritized transport of in of tracking high value ground targets for long durations and potentially engaging to Congressionally-directed effort for Non-Traditional Intelligence, Surveillance, and</li> <li>(U) In FY 2008: Not Applicable.</li> </ul>	formation for purpose hem. Conduct	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>							
<ul> <li>(U) CONGRESSIONAL ADD: Semantic Service Oriented Architectures for Dynamic</li> <li>(U) In FY 2006: Not Applicable</li> <li>(U) In FY 2007: Develop and demonstrate a capability to collaboratively interact and sensitive knowledge across multiple platforms using Semantic Service Oriented A conjunction with Intelligent Agent architectures, Ontological Knowledge, and Ma technology.</li> </ul>	manage sensor context rchitectures, in	0.000	1.800	0.000	0.000		
<ul> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> </ul>		10.916	18.881	6.037	6.981		
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>							
	<u>Y 2009</u> <u>FY 2010</u> stimate <u>Estimate</u>	<u>FY 2011</u> <u>FY 201</u> <u>Estimate</u> <u>Estimate</u>			<u>Total Cost</u>		
<ul> <li>(U) Related Activities:</li> <li>(U) PE 0602702F, Command, Control, and Communications.</li> </ul>				-			
(U) PE 0603203F, Advanced Aerospace Sensors.							
(U) PE 0603742F, Combat Identification Technology.							
<ul> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> </ul>							
R-1 Lir	ne Item No. 34						
Project 4072 Pa	ge-6 of 22 570			Exhibit R-2a (P	'E 0603789F)		

Exhibit R-2a, RDT&E	Project Justification	DATE February 2007
DGET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJECT NUMBER AND TITLE 4072 Dominant Battlespace Awareness
) <b>D. Acquisition Strategy</b> Not Applicable.		
Not Applicable.		
Project 4072	R-1 Line Item No. 34 Page-7 of 22	Exhibit R-2a (PE 060378

		Exhibit R-	2a, RDT&B	E Project	Justificatio	on			DATE	February 2	2007
	ET ACTIVITY dvanced Technology Developme	ent (ATD)			06037	1BER AND TITL 89F C3I Adv opment		42	OJECT NUMBE 16 Battlespa change	R AND TITLE	tion
	Cost (\$ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009		FY 2011	FY 2012	FY 2013	Cost to	Total
4016		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4216	<ul> <li>Battlespace Information Exchange</li> <li>Quantity of RDT&amp;E Articles</li> </ul>	15.796 0	12.490 0	8.012	11.376 0	17.565 0	14.506 0	<u>19.740</u> 0	24.988	Continuing	TBD
(U)	A. Mission Description and Budget	-		0	0	0	0	0	0		
	This project develops and demonstrate exchange of near-real-time multimediand and seamless between Air and Space ( coalition and multi-national force bour and c) provide in-transit visibility of e States (e.g., updating information and advanced information management, m mechanisms, communications transmi information and information systems.	a (i.e., voice, c Operations Cen ndaries; b) sup n route aircraf mission chang nulti-level/secu	lata, video, and nters (AOC) a oport mobile ir ct, cargo, missi ges to en route ire communica	d imagery) int nd aircraft, eit nformation sup on status, and aircraft). Tec ations, secure	formation. Thi ther en route o periority, sense reachback cap hnology devel survivable net	s secure envir r in theater. It or-to-shooter of pabilities for a opments inclu works, missio	onment will b will: a) provid operations, and ircraft to oper de an informa n and content	e rapidly depl de interoperab d the battle ma ations centers ttion assurance -based routing	oyable, mobil- ility across ec anagement dec in the Contin- e decision sup c, quality-of-se	e, interoperabl helons, Servic vision process; ental United port system, ervice	æ,
	B. Accomplishments/Planned Progr	( <b>d</b> • • • • • • • • • • • • • • • • • • •	•				FY 20		2007	<u>FY 2008</u>	FY 2009
(U) (U) (U)	MAJOR THRUST: Develop and dem platforms (e.g. munitions, uninhabited Forces personnel. In FY 2006: Examined and developed Operations Forces ground elements by reachback to globally located comman In FY 2007: Continue to develop or a Forces ground elements by connecting to globally located command centers. networking capability for information uninhabited air systems, ground facilit In FY 2008: Complete development of for information sharing and collabora ground facilities). In FY 2009: Develop small form-facto capability in preparation for transition	onstrate secure d air systems, a l or adapted ne y connecting the nd centers. dapt networke g them into the Develop phas sharing and c ties). of a small form tion with other	e wideband as and aircraft), g etworked comm hem into the a d communicate e airborne netw e one of a sma ollaboration w h-factor prototy r networking a and reachback	round facilitie nunications to irborne netwo ions to suppo vork weapon ill form-factor vith other netw ype information ssets (aircraft	es and Special o support Spec ork weapon pla rt Special Ope platforms and r prototype info vorking assets on networking , uninhabited a	Operations ial atforms and rations reachback ormation (aircraft, capability air systems,	3.2		3.876	0.954	1.134
(U)											
Proj	ect 4216				Line Item No. 3 Page-8 of 22	4				Exhibit R-2a (P	E 0603789F)
					572						

	Exhibit R-2a, RDT&E Project Just	ification		DATE	February	2007	
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Adva Development			JECT NUMBER AND TITLE <b>6 Battlespace Information</b> hange		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	MAJOR THRUST: Proactively defend cyberspace through cyber situational awaren defeating cyber threats, and surviving through adaptation and self-regeneration. Note transitions in FY 2008 from Applied Research PE 0602702F, Project 4519, into this	e: This effort	0.000	0.000	0.782	2.886	
(U)	In FY 2006: Not Applicable.						
(U)	In FY 2007: Not Applicable.						
(U)	In FY 2008: Develop technology demonstration plans for a fleet of cooperative agent mission critical Air Force assets by gathering cyber situational awareness information decision making. Develop secure data sharing to prevent the disclosure of sensitive is untrustworthy users.	n for defensive					
(U)	In FY 2009: Develop technology demonstration plans for active ISR defense on wire Continue cyber situational awareness demonstration. Continue development of secur prevent the disclosure of sensitive information to untrustworthy users.						
(U)							
(U)	MAJOR THRUST: Design, develop, demonstrate, test, and validate an integrated too Modeling and Simulating the Air Force's extension of the Global Information Grid, the Airborne Network. This thrust will provide the Air Force with the ability to accompli- and technical analyses, at the appropriate levels of fidelity, to enable the effective min- systems for the development and evolution of the Airborne Network. Note: This effective 2008 from Applied Research PE 0602702F, Project 4519, into this PE.	he evolving ish both mission gration of legacy	0.000	0.000	0.670	1.374	
(U) (U)	In FY 2006: Not Applicable. In FY 2007: Not Applicable.						
(U)	In FY 2008: Test and validate the modeling and simulation capability using real work determine the accuracy and real-time nature of the capability. Establish enhancement modeling capability and to assess processing requirements.						
(U)	In FY 2009: Continue the validation of the enhanced modeling and simulation capab- tool suite and make it usable by an operational person instead of programmers. Exerc of the modeling capability and apply the model to proposed future DoD networking en	rise the limitations					
(U)							
(U)	MAJOR THRUST: Design, develop, and demonstrate the enterprise management cap on-paper policy (e.g., word documents, or other Air Tasking Orders, etc.) and transla network policy language to provide this "policy meta-data" to a network enterprise s	te that format into	0.000	0.000	0.784	1.019	
Pro	ject 4216 Page-	tem No. 34 9 of 22 73			Exhibit R-2a (	PE 0603789F)	

Exhibit R-2a	a, RDT&E Project Justification		DATI	February	2007
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITL 0603789F C3I Adv Development			UMBER AND TITLE espace Information	
(U) <u>B. Accomplishments/Planned Program (\$ in Million</u> form, in order to re-configure, re-constitute, and streng tactical, and network events (e.g., changes in informatic (THREATCON), defense condition (DEFCON), malic transitions in FY 2008 from Applied Research PE 0602	then Air Force networks in response to strategic, on condition (INFOCON), threat condition tious threat, outages, etc.). Note: This effort	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
<ul> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Design and develop an enterprise manage narrative policy into machine-readable code in order to tactical, and network threats.</li> </ul>					
<ul> <li>(U) In FY 2009: Develop and demonstrate reconfiguration tactical, and network events (e.g., changes in information (THREATCON), defense condition (DEFCON), malic</li> </ul>	on condition (INFOCON), threat condition				
<ul> <li>(U)</li> <li>(U) MAJOR THRUST: Develop and demonstrate offensive experimental cyber craft technology demonstrations. T developed from ongoing offensive cyber programs in the operations in a stealthy manner, gathering intelligence cyber "effects" against the systems. Note: This effort 0602702F, Project 4519, into this PE.</li> </ul>	These demonstrations will integrate capabilities the areas of gaining access to systems, performing from the compromised systems, and launching	0.000	0.000	1.393	2.680
<ul> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Not Applicable.</li> <li>(U) In FY 2008: Initiate development of offensive cyber ca intelligence, and affect adversary information and infor demonstration plans for cyber operations.</li> </ul>					
<ul> <li>(U) In FY 2009: Continue development and demonstrate see Demonstrate and integrated kinetic and cyber operation cyber command and control (Cyber C2) operations fun</li> </ul>	ns planning and execution capability. Develop				
<ul> <li>(U)</li> <li>(U) MAJOR THRUST/CONGRESSIONAL ADD: Develo decision algorithms to prioritize and control resources to in FY 2006 Congressional Add funding.</li> </ul>	op and demonstrate advanced expert system	3.456	0.540	0.000	0.000
Project 4216	R-1 Line Item No. 34 Page-10 of 22			Exhibit R-2a (	PE 0603789E)

	Exhibit R-2a, RDT&E Proje	ct Justification		DATE	February	2007		
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Adva Development						
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2006: Transitioned the combined Intelligent Information Manager, In and the Global Media Access Controller to jump start Network Centric con Congressionally-directed efforts for Information for Global Reach, and Ena Warfare.	nmunications. Conducted	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	In FY 2007: Complete the transition of the combined Intelligent Information Network Controller, and the Global Media Access Controller. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	on Manager, Integrated						
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate in transport and management technology to provide assured, seamless, battles Force with a greatly reduced footprint. Note: This effort includes \$3.9 millimillion in FY 2007 Congressional Add funding.	pace connectivity to the Air	7.139	6.080	3.429	2.283		
(U) (U)	In FY 2006: Developed mechanisms to enable integrated management of con- resources. Assessed communications needed to support ground moving targ- multi-intelligence exploitation and fusion, and sensor resource management Established a framework for integration and development of a common-coo- function for command, control, intelligence, surveillance, and reconnaissant mission/task-based priority and quality of service utilization of communicat fusion-focused ISR tasking, feature-aided tracking, group tracking, and use information. Investigated the complexities of multi-intelligence exploitation enhancements into the development. Continued to develop and demonstrated interconnectivity solution that addresses all intra and inter-platform commu- telemetry/command/control, and payload related data exchange needs of ur and micro satellite platforms. In FY 2007: Demonstrate improved battle management command, control,	get tracking, t systems and techniques. ordinated management ce networking. Developed tions assets to enable of Level 3 type fusion n and incorporated e an efficient on-board optical unications, including manned airborne vehicles						
	networked collaboration capabilities by making improvements in routing, madaptive protocols to show the effectiveness for ISR platforms. Develop an mobile, deployable extension of the global information enterprise to suppor sustainable air power, command and control weapons data links, and ISR a Congressionally-directed effort for Massively Parallel Optical Interconnect	d demonstrate a survivable, t rapid, decisive and ssets. Conduct						
Pro	ject 4216	Page-11 of 22			Exhibit R-2a (I	PE 0603789F)		

	Exhibit R-2a, RDT&E Project Ju	ustification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Adva Development			UMBER AND TITLE espace Information	
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Exchange.					
(U)	In FY 2008: Continue improvements in the battle management command, control					
	networked collaborative capability by demonstrating Air Force airborne networki					
	multi-service environment, enabling aircraft to access each other's ISR airborne a					
	environments. Initiate the development of advanced, automated, network and bar	-				
	technologies to move, manage, and process information in real-time to provide dy Assurance/Quality of Service for the warfighter. Initiate investigation to provide	- •				
	(anti-jam) covert high capacity spectrum dominance for global networking, while					
	the same.	conying the adversary				
(U)	In FY 2009: Complete improvements in the battle management command, control	l. and communications				
(0)	networked collaborative capability by demonstrating Air Force airborne networki					
	multi-service environment, enabling aircraft to access each other's intelligence, su	-				
	reconnaissance (ISR) airborne and ground information environments. Continue t					
	advanced, automated, network and bandwidth management technologies to move	e, manage, and process				
	information in real-time to provide dynamic Quality of Assurance/Quality of Service	vice for the warfighter.				
	Continue investigation to provide assured access (anti-jam) covert high capacity s	spectrum dominance				
	for global networking, while denying the adversary the same.					
(U)						
(U)	CONGRESSIONAL ADD: Griffith Institute - Accelerated Course in Engineering		0.964	0.000	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Griffith Institute - Ad	ccelerated Course in				
(II)	Engineering. In FY 2007: Not Applicable.					
(U) (U)	In FY 2007: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Hybrid Radio Frequency - Optical Communications	Terminal.	0.964	0.994	0.000	0.000
(U)	In FY 2006: Conducted Congressionally-directed effort for Hybrid Radio Freque					
	Communications Terminal. Developed parts and subsystems that can be used in	either optical or RF				
	communications systems, and be used simultaneously for RF and optical communications	nications.				
(U)	(U) In FY 2007: Continue Congressionally directed effort for Hybrid Radio Frequencies					
	Communications Terminal. Continue development of parts and subsystems that c	can be used in either				
	R-11i	ine Item No. 34				
Pro		age-12 of 22			Exhibit R-2a (F	PE 0603789F)
		576				

<ul> <li>optical or RF communications systems, and be used simultaneously for RF and optical communications. Integrate RF and Optical hardware into a common subsystem. Develop the signaling protocols combining optical and RF characteristics. Develop packaging concepts for the combined RF and optical techniques.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Develop training program in cyber security through the completion of research topics covering the areas of security policy, computer security, cryptography, steganography, digital forensics, network security, network defense, network attack, wireless security, and next generation security.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost</li> <li>(D) Total Cost</li> <l< th=""><th>Exhibit R-2a, F</th><th>RDT&amp;E Project J</th><th>lustificat</th><th>ion</th><th></th><th></th><th>DATE</th><th>February</th><th>2007</th></l<></ul>	Exhibit R-2a, F	RDT&E Project J	lustificat	ion			DATE	February	2007	
optical or RF communications systems, and be used simultaneously for RF and optical communications. Integrate RF and Optical hardware into a common subsystem. Develop the signaling protocols combining optical and RF characteristics. Develop packaging concepts for the combined RF and optical techniques. (1) In FY 2008: Not Applicable. (2) (2) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering (3) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering (4) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering (5) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering (5) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering (5) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering (5) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering (6) CONGRESSIONAL ADD: Cyber Security - Cyptography, steganography, digital forensics, network security, network defense, network attack, wireless security, and next generation security. (1) In FY 2009: Not Applicable. (1) (1) In FY 2009: Not Applicable. (1) (2) Total Cost (1) Total Cost (2) Total Cost (2) PC 2006 FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimat			0603	0603789F C3I Advanced 4216				6 Battlespace Information		
<ul> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering 0.000 1.000 0.000 0.000</li> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Develop training program in cyber security through the completion of research topics covering the areas of security onputer security, entwork defense, network attack, wireless security, and next generation security.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U) Total Cost 15.796 12.490 8.012 11.370</li> <li>(U) Total Cost 15.796 FY 2017 FY 2017 FY 2018 FY 2019 FY 2011 FY 2012 FY 2013 Cost to Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Cost</li> <li>(U) Related Activities:</li> <li>(U) Related Activities:</li> <li>(U) PE 606070276F. Command, Control, and Communications.</li> <li>(U) This project has been control and communications.</li> <li>(U) Disported through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) Acquisition Strategr Not Applicable.</li> <li>(U) Strategr Not Applicable.</li> <li>(U) Strategr Not Applicable.</li> <li>(U) Strategr Not Applicable.</li> <li>(U) Reversion Applicable.</li> <li>(U) Reversion Applicable.</li> <li>(U) Reversion Applicable.</li> <li>(U) Reversion Applicable.</li> <li>(U) Acquisition Strategr Not Applicable.</li> <li>(U) Acquisition Strategr Not Applicable.</li> <li>(U) Strategr Not Applicable.</li> <li>(U) Not Applicable.</li> <li>(U) Not Applicable.</li> <li>(U) Applicable.</li> <li>(U) Not Applicable.</li> <li>(U) Strategr Not Applicable.</li> <li>(U) Strategr Not Applicable.</li> <li>(U) Strategr Not Applicable.</li> <li>(U) Not Applicable.</li> <li>(U) Not Applicable.</li> <li>(U) Not Applicable.</li> <li>(U) Not Applicab</li></ul>	optical or RF communications systems, and be used simu Integrate RF and Optical hardware into a common subsys combining optical and RF characteristics. Develop packag techniques.	tem. Develop the signa	aling protoco	ols	<u>FY 2</u>	<u>006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
<ul> <li>In FY 2006: Not Applicable.</li> <li>In FY 2007: Develop training program in cyber security through the completion of research topics covering the areas of security policy, computer security, cryptography, steganography, digital forensics, network security, network defense, network attack, wireless security, and next generation security.</li> <li>In FY 2008: Not Applicable.</li> <li>In FY 2009: Not Applicable.</li> <li>In FY 2009: Not Applicable.</li> <li>Total Cost</li> <li>In FY 2006</li> <li>FY 2007</li> <li>FY 2008</li> <li>FY 2009</li> <li>FY 2010</li> <li>FY 2011</li> <li>FY 2012</li> <li>FY 2013</li> <li>Cost to Applicable.</li> <li>Cost to Applicable.</li> <li>EY 2006</li> <li>FY 2007</li> <li>FY 2008</li> <li>FY 2009</li> <li>FY 2010</li> <li>FY 2011</li> <li>FY 2012</li> <li>FY 2013</li> <li>Cost to Applicable.</li> <li>Cost to Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete Complete Complete Complete Control, and Communications.</li> <li>PE 0602702F, Command, Control, and Communications.</li> <li>This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li><b>U D.Acquisition Strategy</b> Not Applicable.</li> </ul>	<ul><li>(U) In FY 2009: Not Applicable.</li><li>(U)</li></ul>	lourse in Engineering			0.0	200	1 000	0.000	0.000	
<ul> <li>(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2006</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2009</u> <u>FY 2010</u> <u>FY 2011</u> <u>FY 2012</u> <u>FY 2013</u> <u>Cost to</u> <u>Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete</u> (U) Related Activities: (U) PE 0602702F, Command, Control, and Communications.</li> <li>(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>(U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>	<ul> <li>(U) In FY 2006: Not Applicable.</li> <li>(U) In FY 2007: Develop training program in cyber security t covering the areas of security policy, computer security, or network security, network defense, network attack, wirelet</li> <li>(U) In FY 2008: Not Applicable.</li> <li>(U) In FY 2009: Not Applicable.</li> <li>(U)</li> </ul>	hrough the completion cryptography, steganog	raphy, digita	al forensics,						
FY 2006       FY 2007       FY 2008       FY 2009       FY 2010       FY 2011       FY 2012       FY 2013       Cost to Cost to Complete         (U)       Related Activities:       (U)       PE 0602702F, Command, Control, and Communications.       (U)       PE 0602702F, Command, Control, and Communications.       (U)       This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.       (U) <b>D. Acquisition Strategy</b> Not Applicable.					15.	/96	12.490	8.012	11.376	
R-1 Line Item No. 34	FY 2006       FY 2000         Actual       Estimation         (U)       Related Activities:         (U)       PE 0602702F, Command, Control, and Communications.         (U)       This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.         (U)       D. Acquisition Strategy								Total Cost	
Project 4216 Page-13 of 22 Exhibit R-2a (PE 0603789)	Project 4216			34				Evhihit P-22 (	DE 0603780E1	

	Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007	
BUDGET ACTIVITY 03 Advanced Technology Developm	ent (ATD)			06037	1BER AND TITL 89F C3I Adv opment		48	PROJECT NUMBER AND TITLE 4872 Aerospace Information Dominance			
Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
4872 Aerospace Information Dominance	14.633	16.824	13.308	13.693	18.420	17.256	19.153	20.768	Continuing	TBD	
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0			
<ul> <li>Note: Increased funding in FY 2006 and o In FY 2006, efforts from Project 4925 mov</li> <li>(U) A. Mission Description and Budget In order to achieve information domin (air, space and cyberspace) at all leve This project develops and demonstrat warfighter to monitor, assess, plan, ar operations other than war. It will deve operations, allowing decision makers capabilities that will realize a strategy demonstrate distributed information to mobile, dynamic, scalable, globally d</li> </ul>	e to this Project Item Justifica hance, the Air I ls of war (strat es technologies hd execute (MA elop and demon to determine the r-to-task appro- echnologies that	et. <b>Ation</b> Force must be egic, operation is necessary for APE) on the constrate a new gene ne desired oper ach to warfare at provide the	able to plan, a nal, and tactica r dynamic decomplex and co generation of p rational effect , exploiting an decision make	assess, monito al) and during cision making. ompressed time planning and a ts and prosecu nticipatory env er and staff wi	r, and replan r all phases of o It provides th e scales requir assessment tec te the mission vironments and th seamless ac	missions rapid conflict (pre-c e technology a ed for tomorro hnologies that accordingly. ' d agile comma ccess to tailore	ly across the sonflict, confli and demonstration ow's conflicts enable a new This project wound and contro- ad multi-medi	full spectrum of ct and stability ations needed t , whether they y paradigm of the vill develop into of concepts. It a, multi-spectr	of operations operations). to enable the are combat of network enable novative will develop a al data, within	led and	
<ul> <li>technologies to support robust, real-ti</li> <li>(U) <u>B. Accomplishments/Planned Prog</u></li> <li>(U) (U) MAJOR THRUST: Develop and and reconfigurable and provide seam makers and staff in mobile, dynamic,</li> <li>(U) In FY 2006: Investigated a core set o operation centers, enabling the ability across security boundaries in a coalit mission packages with tailorable and management and deconfliction. Con- support information exchange betwee Explored the integration of intelligen detailed advice necessary to make inf federation of systems engineering pri capabilities.</li> </ul>	ram (\$ in Mill demonstrate d less access to t scalable, glob f functionality to plan, direct ion environmen exportable infi tinued develop en operations c t agents that us formed decision	ions) istributed info ailored multi- ally distributed and supportin t, coordinate, a nt. Developed ormation repo ing highly effi enters and oth he physics-base ns. Applied ap	rmation techn media, multi-s l command an g infrastructur ind control ain joint Service rts/briefings a cient business er command a ed modeling to opropriate sys and and contro	allogies that an spectral data for and control cent re for next gen r forces and op collaborative p ssociated with s processes and and control cent o provide accu- tem of system ol decision-sup	re scalable or decision ters. eration perations planning of air space d tools to nters. urate, s and pport	<u>FY 20</u> 3.9		<u>Y 2007</u> 5.479	<u>FY 2008</u> 4.169	<u>FY 2009</u> 2.143	
Project 4872				Line Item No. 3 Page-14 of 22	4				Exhibit R-2a (F	PE 0603789F)	
				578							

	Exhibit R-2a, RDT&E Projec	ct Justification		DATI	DATE February 2007		
	OGET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advan Development	nced		ROJECT NUMBER AND TITLE 72 Aerospace Information ominance		
(U) (U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> In FY 2007: Continue to investigate a core set of functionality and supportin multi-level security repositories for next generation operation centers, enable coordinate, and control air forces and operations across security boundaries. Develop execution of the air space plan and re-planning options to enable dy capabilities; avoiding hazardous conditions. Demonstrate highly efficient but support information exchange between operations centers and other commant Prototype and demonstrate intelligent agents that use physics-based modelin detailed advice necessary to make informed decisions. Develop command ar capabilities. Initiate investigation of the processes and procedures to normal operations with precision munitions to achieve desired effects against our ad space and cyberspace domains. Develop peer-to-peer and publish/subscribe systems and adaptive embedded computing techniques operating within a perfor very high resolution, wide-area, and global positioning system-coded sur development of polymorphic computing technology for persistent surveillan processing and greatly reduced size, weight, and power.	ng infrastructure, including ing the ability to plan, direct, in a coalition environment. ynamic deconfliction usiness processes and tools to and and control centers. ag to provide accurate, and control decision-support lize the use of information dversaries within the air, information distribution ersistent surveillance system rveillance images. Initiate	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	(U) In FY 2008: Complete development of capabilities that allow a networket to plan, direct, coordinate air force assets across security boundaries in a coar and demonstrate the capability to accomplish dynamic air space management manned and unmanned aircraft focused on air control measure parsing, time advanced visualization and seamless collaboration. Develop a campaign of quantitatively measure transformational command and control concepts enal capabilities. Demonstrate command and control decision-support capabilities capability to normalize the use of information operations with precision mur- effects against our adversaries within the air, space and cyberspace domains peer-to-peer and publish/subscribe/query information distribution systems and computing techniques operating within a persistent surveillance system for v- wide-area, and global positioning system-coded surveillance images. Contin- polymorphic (adaptable) computing technology for persistent surveillance sy- processing and greatly reduced size, weight, and power requirements for pro- the development and application of Multi-Level Security/Multiple Single Le (MLS/MSLS) middleware technologies for persistent surveillance systems to the development and application of Multi-Level Security/Multiple Single Le	alition environment. Develop at and de-confliction of aly conflict identification, experimentation to bled by net centric warfare es. Continue to develop the nitions to achieve desired . Complete development of adaptive embedded very high resolution, nue the development of systems using faster processing hardware. Continue evels of Security					
Pro	oject 4872	R-1 Line Item No. 34 Page-15 of 22 579			Exhibit R-2a (	PE 0603789F	

	Exhibit R-2a, RDT&E Proje	ect Justification		DATE	February	2007
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advan Development	nced	PROJECT NUMBER AND TITLE 4872 Aerospace Information Dominance		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	of information at multiple security levels.					
(U)	(U) In FY 2009: Initiate the development of capabilities to allow seamless					
	enhanced situational awareness and understanding by the decision maker. C an initial capability to plan and measure effectiveness of information opera	-				
	precision munitions to determine successful achievement of command inter	-				
	achieve "self-synchronization." Continue campaign of experimentation to					
	transformational command and control concepts enabled by net centric war					
	the development of polymorphic (adaptable) computing technology for per					
	using faster processing and greatly reduced size, weight, and power require	ements for processing				
	hardware. Continue the development and application of Multi-Level Secur					
	Security (MLS/MSLS) middleware technologies for persistent surveillance	e systems to support user				
	access/denial of information at multiple security levels.					
(U)	(I) MAIOD TUDUCT D. 1		2 2 2 2	2 0 9 2	1.045	0.004
(U)	(U) MAJOR THRUST: Develop and demonstrate the integration of plannin information-based intelligent agents for adaptive preplanning and decision	-	2.282	3.983	1.245	0.694
	command and control systems	support tools for All Force				
(U)	In FY 2006: Developed tools and technologies to revolutionize air mobility	v information superiority to				
(-)	respond swiftly and effectively to global demands across all spectrums of c					
	relief to a major conflict. Developed advanced reasoning techniques for mo	-				
	development. Applied the use of advanced computer mark-up languages ar	nd developed a common				
	mobility ontology to improve automation of decision support tools for increase					
	planning, and execution management. Investigated the feasibility of a capa	-				
	system/program-centric global warfighting response by "bridging the seam	-				
	processes and systems in the Combat Air Force (CAF), Mobility Air Force					
	Management (ATM) domains. Developed improved synchronization amon Mobility Force participants within multiple theaters and global Civil ATM.	-				
	support collaborative command and control, including dynamic and interm					
	Developed automated machine-to-machine exchange of selected informatio					
	MAF aircraft, their respective command and control elements, and civil AT					
	feasibility of virtual staff members to maintain a vision of command and co	•				
	absences providing a 24/7 coverage.					
		R-1 Line Item No. 34				
Pro	pject 4872	Page-16 of 22			Exhibit R-2a (	PE 0603789F)

	Exhibit R-2a, RDT&E Proj	DAT	DATE February 2007			
	DGET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advand Development	ced	PROJECT NUM 4872 Aeros Dominance		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	respond swiftly and effectively to global demands across all spectrums of relief to a major conflict. Demonstrate advanced reasoning techniques for development. Demonstrate the use of common mobility ontology to impro- support tools for increased situational awareness, planning, and execution technologies to enable a CAF, MAF, civilian shared situational awareness desired "effects" and ensure mission success in a global environment. Der synchronization among Global Strike and Global Mobility Force participa and global Civil ATM. Demonstrate the capability to support collaborativ- including dynamic and intermittent participation of players. Develop addir machine-to-machine exchange capabilities between CAF aircraft, MAF ai command and control elements, and civil ATM agencies, and demonstrate and interoperability between CAF and MAF mission planning and executi- velocity, efficiency, safety, and mission success. Develop appropriate virt a vision of command and control processes during human absences provid In FY 2008: Complete development of improved synchronization among of Mobility Force participants within multiple theaters and global Civil air tr Complete automated machine-to-machine exchange of selected informatio aircraft, MAF aircraft, and their respective command and control elements optimization capability by exploiting information discovery and delivery, distributed optimization techniques, and evaluation models to support mol emphasis on increased efficiency and decreased routine workload across f positions. Demonstrate capability for cross-functional collaboration that w awareness and understanding during mission planning and execution to al execution teams to self-synchronize, ensuring a highly coordinated effort. next generation tools and technologies to revolutionize air mobility inform swiftly to global demands across all spectrums of operations from humani	operations from humanitarian mobility courses-of-action ove automation of decision management. Develop /synchronization to achieve nonstrate improved nts within multiple theaters e command and control, tional automated rcraft, their respective e improved information sharing on systems for improved ual staff members to maintain ling a 24/7 coverage. Global Strike and Global affic management (ATM). on capabilities between CAF s. Complete multi-mission advanced, multi-constraint and polity operations with special unctional and supervisory vill increase situation low the planning and Complete development of nation dominance to respond tarian relief to a major conflict. net centric enabled n capabilities that account for decision making process				
		R-1 Line Item No. 34				

	Exhibit R-2a, RDT&E Project Justification February 2007										
03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Adva Development			IBER AND TITLE	BER AND TITLE ace Information					
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>					
	strengths of machines (process lots of data) and human (analytical reasoning). I workflow and workload management capabilities to manage the command and resources.										
(U)											
	MAJOR THRUST: Develop, demonstrate, and integrate a broad range of techn application within embedded information architecture applicable to manned and Note: In FY 2006, this effort completed.	0.804	0.000	0.000	0.000						
	In FY 2006: Developed and demonstrated a Time Sensitive Target automated d for an Advanced Technology Aerospace Operations Center type of facility in a										
	In FY 2007: Not Applicable.										
• •	In FY 2008: Not Applicable.										
	In FY 2009: Not Applicable.										
(U)			0 511	1.1.0	2 (00)	4 401					
(U)	MAJOR THRUST: Develop and demonstrate an effects-based approach for the planning and assessment techniques that enable decision makers to determine the effects (nth-order) at the right place at the right time, anywhere, anytime.	6	3.711	4.468	3.600	4.481					
(U)	In FY 2006: Developed new concepts and technologies supporting effects-base	d planning, execution,									
Ì.	and assessment by enabling the generation, tasking, and assessment of effects-b										
	execution orders. Developed capabilities to support air operations center person	-									
	assessing, in near-real-time, various course of action options based upon comm	ander's intent, predictive									
1	battlespace awareness tools, and the ability to reason over models of the "enemy	y as a system."									
	Developed technologies to capture, assess, and integrate cause-and-effect (first,										
1	relationships endemic to this "enemy as a system." Investigated advanced inform	-									
1	shorten the current execution timelines, while also allowing significant reduction										
1	personnel required in operation centers. Developed warfighter-accepted operati	-									
	architecture views for a Streaming Air Tasking Order (ATO) generator and dyn										
	assessment capability. Developed initial spiral developments of concept demon										
	ATO generation capability. This will enable more responsive and continuous plassessment within the operations center	aming, execution, and									
an	assessment within the operations center. In FY 2007: Develop improved technologies to support effects-based planning,	execution and									
(0)	assessment by enabling the generation, tasking, and assessment of effects-based										
	R-1	Line Item No. 34									
Proj		Page-18 of 22			Exhibit R-2a (	PE 0603789F)					

	Exhibit R-2a, RDT&E Proje	DATI	DATE February 2007				
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advan Development	ced		NUMBER AND TITLE ospace Information Ice		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> orders. Develop improvements to support operations center personnel in ass options, based upon commander's intent, predictive battlespace awareness to over models of the "enemy as a system." Develop technologies to capture, a cause-and-effect (first, second, and third order) relationships endemic to this Develop advanced information technologies to shorten the current execution allowing significant reductions in the number of personnel required in an op streaming ATO prototype capability. Develop real-time operational assessm streaming ATO environment that will enable an effects-based approach to op will allow greater visibility into whether or not desired effects are being ach	bools, and the ability to reason assess, and integrate s "enemy as a system." In timelines, while also perations center. Develop a ment demonstration in a operational assessment, which	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Demonstrate concepts and technologies supporting effects-base assessment by enabling the generation, tasking, and assessment of effects-base technologies to allow operations center personnel to assess, in near-real-tim (COA) options based upon command intent. Develop technologies to captur cause-and-effect (first, second, and third order) relationships endemic to this Complete the operational concept and architecture for effects based assess development and experimentation to determine the ability of developed cap in conducting accurate and timely assessments. Complete the development assess status of planned actions against adversary systems to determine whe actually achieved. Initiate an analysis of cascading effects in real-time for conducting the "best" blue course of action for Rapid, Decide, Act and Adapt (RDAA). ability to forecast potential adversaries and events based on indications of k known and/or anticipated threat(s).	ed planning, execution, and ased tasking. Demonstrate e, various courses of action re and assess integrated s "enemy as a system." nent to drive software abilities to assist warfighters of techniques to continually ether predicted effects are liverse courses of action. ability to appraise and plan Initiate investigation of					
(U)	In FY 2009: Demonstrate technology to meet the needs for effects-based as environment. Design, develop and demonstrate the capabilities for continuo in a dynamic tasking environment. Demonstrate techniques to accomplish u whether the execution of the battle plan is meeting the desired effects. Inve a decision support environment that enables the decision maker to anticipate future battlespace. Initiate development of predictive battlespace awareness reason over models of the "enemy as a system." Continue analysis of casca diverse courses of action. Continue research to forecast actionable futures t	us effects based assessment p-to-date awareness on stigate the methods to enable e and shape all aspects of the s tools with the ability to ding effects in real-time for o support a decision maker's					
Prc	ject 4872	R-1 Line Item No. 34 Page-19 of 22			Exhibit R-2a (	PE 0603789F)	

	Exhibit R-2a, RDT&E Projec	ct Justification		DATE	Exhibit R-2a, RDT&E Project Justification February 2007										
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advan Development	iced		ECT NUMBER AND TITLE Aerospace Information inance										
	<b>B. Accomplishments/Planned Program (\$ in Millions)</b> ability to appraise and plan the "best" blue course of action for Rapid, Decid Continue investigation of ability to forecast potential adversaries and events known evidence and projected known and/or anticipated threat(s). Initiate a Service (QoS) and Quality of Assurance (QoA) integration to the information malicious and non-malicious faults.	based on indications of assured end-to-end Quality of	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>									
(U) (U)	MAJOR THRUST: Develop and demonstrate high performance computing power-limited applications, and emulate older computing components. Note FY 2008 from Applied Research PE 0602702F, Project 4594, into this PE.	-	0.000	0.000	1.354	0.693									
(U) (U)	In FY 2006: Not Applicable. In FY 2007: Not Applicable.														
(U) (U)	In FY 2008: Develop high performance computing for size, weight, and pow Transition power efficient processors to DoD users by addressing power, pre- issues. Develop and demonstrate emulation of older computing component re-use of existing software while gaining the advantages of modern semicon- technology. In FY 2009: Complete development of high performance computing for size applications. Support the resulting hardware and software transition to the u- of reliably autonomic small platforms for unmanned operations. Initiate dev techniques, standards, and technologies to build highly complex software-in-	ogrammability, and radiation as and boards, allowing iductor processing e, weight, and power-limited users. Initiate development velopment of tools,													
(U) (U)	(U) MAJOR THRUST/CONGRESSIONAL ADD: Demonstrate how a public information management paradigm can enable vertical and horizontal integristic control, communication, computers, intelligence, surveillance, and reconnait Develop advanced prototypes of a Community Of Interest (COI) infosphere management requirements of various Air Force net-centric COI's. Demonst can interact with and enhance the current net-centric operations infrastructure includes \$1.3 million in FY 2006 Congressional Add funding. In FY 2006: Developed initial next generation COI infosphere prototypes to	ration of Air Force command, ssance information systems. that support information rate how such an infosphere re. Note: This effort	3.908	2.894	2.940	5.682									
	performance, security to Air Force standards, and high levels of scalability to operational needs. Supported information engineering efforts allowing variables are set of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the standards of the s	o meet Air Force net-centric ous existing and new Air													
		R-1 Line Item No. 34													

	Exhibit R-2a, RDT&E Proje	DAT	DATE February 2007				
	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advan Development	nced		NUMBER AND TITLE rospace Information nce		
(U)	<b>B. Accomplishments/Planned Program (\$ in Millions)</b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
	Force systems to utilize COI infosphere prototypes. Conducted Congressio	nally-directed efforts for					
(III)	secure Battlespace Information Exchange.	a and now Air Fores systems					
U)	In FY 2007: Ramp down information engineering efforts that allow existin to utilize COI infosphere prototypes. Develop next generation COI infosph						
	performance, security to Air Force standards, and high levels of scalability.	-					
	information management to enable information exchange across the enterpr	•					
	Initiate the development of information management infrastructure to federa	-					
	infospheres and across distinct information based communities.						
(U)	-	ormation objects from					
	diverse sources and data environments within and across the tactical edge.	Apply adaptor technology to					
	allow existing Air Force systems to rapidly integrate with and utilize COI in	nformation sources, with a					
	special emphasis on distributed and decentralized information brokering tec	chnology to enhance systems					
	integration of information sources across the global information enterprise a						
	topology constraints. Complete information engineering efforts focusing on						
	(Unit C2) and the Installation Control Center (ICC) goals of providing unit						
	integrated, standardized enterprise capability to control and manage resource	-					
	missions; providing the ability to collaborate and synchronize Unit enterprise.						
	Warfighting Headquarters; and sharing information real time in the accomp day-to-day operations or in generating aircraft to support the wartime Air T						
	the development of technologies that enable a generic methodology for the	-					
	across multiple security level boundaries. Develop capability integrating ta						
	information management requirements. Initiate development of information	-					
	adaptive information management services that learn, self-configure, self-m						
	Initiate a study on collaboration services on demand that will exploit dynam						
	matching end user devices (laptops, cell phones, etc.) with appropriate infor	rmation formats. Continue to					
	support development of COI Infospheres in the areas of context aware colla	borative user interfaces and					
	semantic interoperability.						
U)	In FY 2009: Develop and demonstrate technologies that enable pub/sub/qu	ery information					
	dissemination across multiple security level boundaries. Initiate the study of	-					
	technology to assess, evaluate and convert unstructured information into str						
	Demonstrate capability integrating tactical and edge user information mana	gement requirements.					
		R-1 Line Item No. 34					
Pro	ject 4872	Page-21 of 22			Exhibit R-2a (	DE 0603780E)	

		Exhibit	: R-2a, RD	ſ&E Proje¢	ct Justifica	tion			DATE	February	2007
	GET ACTIVITY Advanced Technology Develo	opment (ATD	)		0603	UMBER AND TI 3789F C3I Ac elopment		4	ROJECT NUMBI 872 Aerospa ominance		ion
(U) (U)	<b>B. Accomplishments/Planned</b> Continue development of inform services that learn, self-configur services on demand that will exp cell phones, etc.) with appropria user interfaces and semantic inter	nation transform e, self-manage, ploit dynamic in te information	nation services and are self-h nformation services	ealing. Contin vices matching	ue study on co gend user devic	llaboration ces (laptops,	<u>FY 2</u>	<u>006 I</u>	₹ <u>¥ 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Total Cost						14.	633	16.824	13.308	13.693
(U)	C. Other Program Funding Su Related Activities: PE 0602702F, Command, Control, and Communications. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>mmary (\$ in N</u> <u>FY 2006</u> <u>Actual</u>	<u>fillions</u> ) <u>FY 2007</u> <u>Estimate</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Prc	oject 4872				R-1 Line Item No Page-22 of 22 586 JNCLASSIF	2				Exhibit R-2a (F	PE 0603789F)

#### PE NUMBER: 0603924F PE TITLE: High Energy Laser Advanced Technology Program

	Exhibit R-2,	RDT&E B	udget Iten	n Justifica	tion			DATE	February 2	2007
BUDGET ACTIVITY 03 Advanced Technology Develo	pment (ATD)				IBER AND TITL 2 <b>4F High En</b>		Advanced T	echnology F		
	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Cost (\$ in Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Total Program Element (PE)	Cost 5.559	3.699	3.815	4.152	4.255	4.322	4.407	4.499	Continuing	TBI
5095 High Energy Laser Advanced Technology Program	5.559	3.699	3.815	4.152	4.255	4.322	4.407	4.499	Continuing	TBI
This program funds high energy l potential advantages, including sp the potential to perform a wide va anti-aircraft missiles; and the ultr Defense (DoD) HEL Science and Budget Activity 3, Advanced Tec developments that have military to	beed-of-light veloc riety of military m a-precision negatic Technology progr hnology Developr	ity, high precisitissions included on of targets in am. Technologien, since it e	sion, significa ing interceptio urban environ ogy addressed nables and de	nt magazine d on of ballistic nments with no in this area ind	epth, low-cost missiles in boo o collateral da cludes the HE	per kill, and i ost phase; defe mage. This pi L JTO Electric	educed logist at of high-spe ogram is part c Laser initiati	ics requirement ed, maneuver of an overall ive. This prog	nts. HELs hav ing anti-ship a Department of ram is in	re Ind
U) <u>B. Program Change Summary</u>	( <mark>\$ in Millions</mark> )	C								
(U) Previous President's Budget					<u>FY 20</u> 5.7		<u>FY 2007</u> 3.713		<u>2008</u> 3.781	<u>FY 2009</u> 4.106
(U) Current PBR/President's Budget					5.5		3.699		3.815	4.152
(U) Total Adjustments					-0.1	54				
U) Congressional Program Reductio	ns									
<b>Congressional Rescissions</b>							-0.014			
Congressional Increases										
Reprogrammings										
SBIR/STTR Transfer					-0.1	54				
(U) <u>Significant Program Changes:</u>										
Not Applicable.										
C. Performance Metrics										
Under Development.										
			R-1	Line Item No. 3	6					
				Page-1 of 4					Exhibit R-2 (Pl	E 0603924F)
				587						
			UN	CLASSIFIE	D					

		Exhibit R-	2a, RDT&I	E Project	Justificatio	on			DATE	February	2007	
	ET ACTIVITY dvanced Technology Developme	ent (ATD)			06039	IBER AND TITL 24F High En Iced Techno		50	PROJECT NUMBER AND TITLE 5095 High Energy Laser Advanced Technology Program			
	Cost (\$ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
5095	High Energy Laser Advanced Technology Program	5.559	3.699	3.815	4.152	4.255	4.322	4.407	4.499	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0			
	<b>A. Mission Description and Budget</b> This program funds high energy laser potential advantages, including speed- the potential to perform a wide variety anti-aircraft missiles; and the ultra-pre Defense (DoD) HEL Science and Tec Budget Activity 3, Advanced Technol developments that have military utility	(HEL) advance of-light velocity of military metricision negation hnology progr ogy Developn	ed technology ity, high precis issions includ n of targets in am. Technolo nent, since it e	sion, significating interception urban environegy addressed nables and de	int magazine d on of ballistic nments with ne in this area ine	epth, low-cost missiles in boo o collateral da cludes the HE	t per kill, and t ost phase; defe mage. This pr L JTO Electric	reduced logist eat of high-sp rogram is part c Laser initiat	tics requirement eed, maneuver t of an overall ive. This prog	nts. HELs hav ing anti-ship a Department o gram is in	ve and	
(U) (U)	<b>B. Accomplishments/Planned Prog</b> MAJOR THRUST: Advance solid st demonstrations up to a Technology R scale to high power. Develop beam- In FY 2006: Began the phase III of th Air Force, Army, and Navy, to demon	ate laser devel eadiness Leve control techno ne Joint High I nstrate 100 kilo	opment, to inc l 6. Develop f logies for surf Power Solid St owatt laborato	ree electron la ace and air m tate Laser (JH ry laser devic	aser technolog ission areas. PSSL) project es. Conducted	with the l necessary	<u>FY 20</u> 5.5		<u>Y 2007</u> 3.699	<u>FY 2008</u> 3.815	<u>FY 2009</u> 4.152	
(U)	studies to understand and improve fie 100 kilowatt class free electron laser of In FY 2007: Continue the developmer requirements for other high-value exp appropriate. Investigate advanced bea leading to a 100 kilowatt class free electron	demonstration ent of the 100 l periments to fo am control arc	cilowatt JHPS llow the 100 k hitectures and	SL developme tilowatt project algorithms.	ent. Determin ct, and begin p	e the lanning as						
(U)	In FY 2008: Continue the developme government-sponsored measurements integration onto airborne platforms. I for mating with the JHPSSL phase III user evaluation.	ent of the 100 l of the 100 kil nitiate joint hi	kilowatt JHPS owatt laser(s). gh-power beau	SL project. P Initiate system Marin director dev	ems level studi velopment effo	ies for ort, suitable						
· /	In FY 2009: Demonstrate 100 kilowa director development effort and integ			•								
Proje	ect 5095			R-1	Line Item No. 3 Page-2 of 4	6				Exhibit R-2a (P	E 0603924F)	
					588							

		Exhibit	: R-2a, RD	F&E Projec	t Justificat	tion				DATE February 2007			
	GET ACTIVITY Advanced Technology Devel	opment (ATD	)		0603	JMBER AND TIT 924F High E anced Techn	nergy Laser		PROJECT NUMBE	CT NUMBER AND TITLE High Energy Laser Advanced nology Program			
(U)	<b>B.</b> Accomplishments/Planned	Program (\$ in	<u>Millions)</u>				<u>FY 20</u>	<u>006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	laser, in preparation for a weapo	on system demo	nstration. Part	icipate in the A	Advanced Tacti	cal Laser							
	extended user evaluation.												
(U)	Total Cost						5.5	559	3.699	3.815	4.152		
U)	C. Other Program Funding Su	mmary (\$ in N	<u>(illions)</u>										
		FY 2006	FY 2007	FY 2008	FY 2009	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	Cost to	Tetal Car		
		Actual	<b>Estimate</b>	<b>Estimate</b>	<b>Estimate</b>	<b>Estimate</b>	<b>Estimate</b>	<u>Estimat</u>	<u>e Estimate</u>	<u>Complete</u>	I OTAL COST		
U)	PE 0602500F,												
	Multi-Disciplinary Space												
	Technology.												
	PE 0602890F, High Energy												
	Laser Research.												
	PE 0603444F, Maui Space												
	Surveillance System.												
,	PE 0603500F,												
	Multi-Disciplinary Advanced												
	Development Space Technology.												
	PE 0603605F, Advanced												
	Weapons Technology.												
	PE 0601108F, High Energy												
	Laser Research Initiatives.												
	PE 0603883C, Ballistic												
	Missile Defense Boost Phase												
	Segment.												
U)	PE 0602605F, Directed												
	Energy Technology.												
	PE 0602307A, Advanced												
	Weapons Technology.												
	PE 0602114N, Power												
	Projection Applied Research.												
U)	This project has been												
Proi	ect 5095			I	R-1 Line Item No. Page-3 of 4	. 36				Exhibit R-2a (I	PF 06039241		
110					589						L 0003924		

Exhibit R-2a, RDT&E Pro	ject Justification		DATE February 2007	
BUDGET ACTIVITY 3 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program	PROJECT NUMBER AND TITLE 5095 High Energy Laser Advance Technology Program		
<ul> <li>U) <u>C. Other Program Funding Summary (\$ in Millions)</u> coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.</li> <li>U) <u>D. Acquisition Strategy</u> Not Applicable.</li> </ul>				
Project 5095	R-1 Line Item No. 36 Page-4 of 4		Exhibit R-2a (PE 0603924	