DEPARTMENT OF THE AIR FORCE

FISCAL YEAR (FY) 2009 BUDGET ESTIMATES

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

DESCRIPTIVE SUMMARIES, VOLUME I

BUDGET ACTIVITIES 1 - 3

FEBRUARY 2008



UNCLASSIFIED

Fiscal Year 2009 Program And Budget Estimates RDT&E Descriptive Summaries, Volume I Scientific and Technology Budget Activities 1 - 3 Feburary 2008

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 2009 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 2009 RDT&E program with the exception of classified program elements. The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional committees insofar as possible.
 - b) The "Other Program Funding Summary" portion of the R-2 includes, in addition to RDT&E funds, Procurement funds and quantities, Military Construction appropriation funds on specific development programs, Operations and Maintenance appropriation funds where they are essential to the development effort described, and where appropriate, Department of Energy (DOE) costs.
 - c) "Facilities Exhibits", Military Construction Project Data, (DD 1391), for improvements to and construction of government-owned facilities funded in RD&E are included in this submission.

2. (U) CLASSIFICATION

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

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USAF Modeling and Simulation	0207601F	1465
Warfighter Rapid Acquisition Program	0203761F	1211
Wargaming and Simulation Centers	0207605F	1487
Distributed Training and Exercises	0207697F	1493
WEATHER SERVICE	0305111F	1671
Wideband MILSATCOM (Space)	0603854F	629
WWMCCS/GLOBAL COMMAND & CONTROL SYSTEM	0303150F	1589

DEPARTMENT OF DEFENSE

FY 2009 RDT&E PROGRAM

SUMMARY (\$ IN THOUSANI	S)		23 JAN 2008
	FY 2007	FY 2008	FY 2009

Research, Development, Test & Eval, AF	24,491,745	26,069,228	28,066,617
Tanker Replacement Transfer Fund, AF		150,000	
Total Research, Development, Test & Evaluation	24,491,745	26,219,228	28,066,617

APPROPRIATION

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DEPARTMENT OF DEFENSE

FY 2009 RDT&E PROGRAM

SUMMARY (\$ IN THOUSANDS) 23 JAN 2008

Summary Recap of Budget Activities	FY 2007	FY 2008	FY 2009
Basic Research	395,300	571,095	452,300
Applied Research	1,115,280	1,169,833	1,044,495
Advanced Technology Development	1,030,162	663,931	578,263
Advanced Component Development & Prototypes	2,479,567	2,692,835	2,440,136
System Development & Demonstration	4,559,857	4,245,953	4,953,574
RDT&E Management Support	1,405,050	1,049,026	1,084,345
Operational Systems Development	13,506,529	15,826,555	17,513,504
Total Research, Development, Test & Evaluation	24,491,745	26,219,228	28,066,617
Summary Recap of FYDP Programs			
Strategic Forces	209,259	135,620	120,289
General Purpose Forces	4,013,382	3,514,541	4,358,254
Intelligence and Communications	9,277,447	11,653,705	12,794,513
Mobility Forces	680,872	1,039,049	678,316
Research and Development	10,035,375	9,573,424	9,806,908
Central Supply and Maintenance	209,939	222,286	233,783
Training Medical and Other	3,369	3,222	3,330
Administration and Associated Activities	58,315	73,365	67,314
Support of Other Nations	3,787	4,016	3,910
Total Research, Development, Test & Evaluation	24,491,745	26,219,228	28,066,617

DEPARTMENT OF THE AIR FORCE

FY 2009 RDT&E PROGRAM

SUMMARY (\$ IN THOUSANDS)

23 JAN 2008

Summary Recap of Budget Activities	FY 2007	FY 2008	FY 2009
Basic Research	395,300	421,095	452,300
Applied Research	1,115,280	1,169,833	1,044,495
Advanced Technology Development	1,030,162	663,931	578,263
Advanced Component Development & Prototypes	2,479,567	2,692,835	2,440,136
System Development & Demonstration	4,559,857	4,245,953	4,953,574
RDT&E Management Support	1,405,050	1,049,026	1,084,345
Operational Systems Development	13,506,529	15,826,555	17,513,504
Total Research, Development, Test & Eval, AF	24,491,745	26,069,228	28,066,617
Summary Recap of FYDP Programs			
Strategic Forces	209,259	135,620	120,289
General Purpose Forces	4,013,382	3,514,541	4,358,254
Intelligence and Communications	9,277,447	11,653,705	12,794,513
Mobility Forces	680,872	889,049	678,316
Research and Development	10,035,375	9,573,424	9,806,908
Central Supply and Maintenance	209,939	222,286	233,783
Training Medical and Other	3,369	3,222	3,330
Administration and Associated Activities	58,315	73,365	67,314
Support of Other Nations	3,787	4,016	3,910
Total Research, Development, Test & Eval, AF	24,491,745	26,069,228	28,066,617

EXHIBIT R-1

APPRO:	PRIATION: 36	00F Research, Development, Test & Eva.	L, AF			Date: 23 JAN 20	08
	Program			Thou	sands of Dollars		s
No	Element Number	Item	Act	FY 2007	FY 2008	FY 2009	E C
							-
1	0601102F	Defense Research Sciences	01	271,481	288,601	309,926	U
2	0601103F	University Research Initiatives	01	111,803	119,938	125,949	U
3	0601108F	High Energy Laser Research Initiatives	01	12,016	12,556	13,425	U
4	0301555F	Classified Programs	01				
5	0301556F	Special Program	01				
6	0305172F	Combined Advanced Applications	01				
	Basic R	esearch		395,300	421,095	452,300	
7	0602015F	Medical Development	02		4,670		U
8	0602102F	Materials	02	151,438	179,516	117,143	U
9	0602201F	Aerospace Vehicle Technologies	02	115,423	139,855	122,870	U
10	0602202F	Human Effectiveness Applied Research	02	106,435	92,068	82,091	U
11	0602203F	Aerospace Propulsion	02	220,143	217,172	218,049	υ
12	0602204F	Aerospace Sensors	02	130,517	121,242	109,048	U
13	0602601F	Space Technology	02	101,316	128,397	117,519	U
14	0602602F	Conventional Munitions	02	60,150	58,632	55,963	υ
15	0602605F	Directed Energy Technology	02	48,487	56,915	62,871	υ
16	0602702F	Command Control and Communications	02	125,791	121,417	109,492	U
17	0602890F	High Energy Laser Research	02	55,580	49,949	49,449	U
	Applied	Research		1,115,280	1,169,833	1,044,495	
18	0603112F	Advanced Materials for Weapon Systems	03	83,546	54,871	41,926	U
19	0603203F	Advanced Aerospace Sensors	03	56,634	62,332	56,916	υ
20	0603211F	Aerospace Technology Dev/Demo	03	45,443	66,884	44,918	U

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EXHIBIT R-1

Date: 23 JAN 2008

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

T d m n	Program	Thousands of Dollars			S		
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	Е С
							-
21	0603216F	Aerospace Propulsion and Power Technology	03	150,123	142,543	170,856	υ
22	0603231F	Crew Systems and Personnel Protection Technology	03	39,503	38,406	26,630	U
23	0603270F	Electronic Combat Technology	03	27,599	26,762	21,056	U
24	0603311F	Ballistic Missile Technology	03	9,128			U
25	0603401F	Advanced Spacecraft Technology	03	105,422	100,600	80,958	U
26	0603444F	Maui Space Surveillance System (MSSS)	03	49,502	42,160	4,838	U
27	0603601F	Conventional Weapons Technology	03	38,602	18,379	11,813	U
28	0603605F	Advanced Weapons Technology	03	74,683	74,383	44,507	U
29	0603680F	Manufacturing Technology Program	03			39,729	U
30	0603789F	C3I Advanced Development	03	47,352	32,821	30,103	U
31	0603801F	Special Programs	03	299,029			υ
32	0603924F	High Energy Laser Advanced Technology Program	03	3,596	3,790	4,013	U
	Advance	d Technology Development		1,030,162	663,931	578,263	
33	0603260F	Intelligence Advanced Development	04	4,757	5,892	4,988	U
34	0603287F	Physical Security Equipment	04	1,248	2,847	477	U
35	0603421F	NAVSTAR Global Positioning System III	04	291,556	482,845		U
36	0603423F	Global Positioning System III - Operational Control Segment	04			2,975	U
37	0603427F	GPS Operational Control Segment - Backwards Compatibility	04			304,360	U
38	0603430F	Advanced EHF MILSATCOM (SPACE)	04	617,294	599,353	388,041	U
39	0603432F	Polar MILSATCOM (SPACE)	04	33,983	177,535	237,749	U

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EXHIBIT R-1

Date: 23 JAN 2008

APPROPRIATION:	3600F	Research,	Development,	Test	&	Eval,	AF
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Program Line Element			Thousands of Dollars					
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	ĉ	
							-	
40	0603438F	Space Control Technology	04	23,605	66,182	76,845	U	
41	0603742F	Combat Identification Technology	04	23,389	25,875	29,400	U	
42	0603790F	NATO Research and Development	04	4,003	4,253	4,334	U	
43	0603791F	International Space Cooperative R&D	04	574	610	627	U	
44	0603845F	Transformational SATCOM (TSAT)	04	700,429	804,739	842,974	U	
45	0603850F	Integrated Broadcast Service	04	24,471	21,058	21,105	U	
46	0603851F	Intercontinental Ballistic Missile	04	56,286	31,121	65,629	U	
47	0603854F	Wideband Global SATCOM RDT&E (Space)	04	43,998	19,091	12,422	U	
48	0603858F	Space Radar	04	183,201			U	
49	0603859F	Pollution Prevention	04	6,829	10,968	2,877	U	
50	0603860F	Joint Precision Approach and Landing Systems	04	9,524	7,451	7,479	υ	
51	0604015F	Next Generation Bomber	04	37,476			U	
53	0604796F	Alternative Fuels	04			28,464	U	
54	0604830F	Automated Air-to-Air Refueling	04			9,889	U	
55	0604856F	Common Aero Vehicle (CAV)	04	31,523	3,974		U	
56	0604857F	Operationally Responsive Space	04	42,131	96,516	110,032	U	
57	0305178F	National Polar-Orbiting Operational Environmental Satellite System (NPOESS)	04	343,290	332,525	289,469	U	
	Advanced	d Component Development & Prototypes		2,479,567	2,692,835	2,440,136		
58	0603840F	Global Broadcast Service (GBS)	05	23,157	29,098	18,790	U	
59	0604222F	Nuclear Weapons Support	05	14,839	20,191	20,166	U	
60	0604226F	B-1B	05	153,757	152,164	128,871	υ	

EXHIBIT R-1

Date: 23 JAN 2008

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

Line	Program Element			Thousands of Dollars			
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	C
61	0604233F	Specialized Undergraduate Flight Training	05	4,112	14,927	7,462	U
62	0604240F	B-2 Advanced Technology Bomber	05	214,649	295,945	351,417	U
63	0604261F	Personnel Recovery Systems	05	103,337	104,289		U
64	0604270F	Electronic Warfare Development	05	95,949	102,601	54,995	υ
65	0604287F	Physical Security Equipment	05	90	34	52	U
66	0604329F	Small Diameter Bomb (SDB)	05	122,276	144,279	125,067	U
67	0604421F	Counterspace Systems	05	44,596	63,819	74,918	U
68	0604425F	Space Situation Awareness Systems	05	166,696	196,363	210,501	U
69	0604429F	Airborne Electronic Attack	05	12,033	23,826	34,279	U
70	0604441F	Space Based Infrared System (SBIRS) High EMD	05	677,926	583,317	529,771	U
71	0604443F	Third Generation Infrared Surveillance (3GIRS)	05	67,552	75,410	149,064	U
72	0604602F	Armament/Ordnance Development	05	13,039	3,165	2,095	U
73	0604604F	Submunitions	05	8,304	1,976	1,730	U
74	0604617F	Agile Combat Support	05	9,715	12,146	5,790	U
75	0604618F	Joint Direct Attack Munition	05	20,959			U
76	0604706F	Life Support Systems	05	11,273	13,563	10,998	U
77	0604735F	Combat Training Ranges	05	16,325	17,546	28,047	U
78	0604740F	Integrated Command & Control Applications (IC2A)	05	26,507	26,593	177	U
79	0604750F	Intelligence Equipment	05	4,907	5,037	1,488	U
80	0604762F	Common Low Observables Verification System (CLOVerS)	05	4,361			Ŭ
81	0604800F	Joint Strike Fighter (JSF)	05	2,074,021	1,991,537	1,524,016	U

EXHIBIT R-1

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

Line	Program Element		Thousands of Dollars				
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	ĉ
82	0604853F	Evolved Expendable Launch Vehicle Program (SPACE)	05	19,083		33,719	υ
83	0605011F	RDT&E for Aging Aircraft	05	36,144	20,491	13,828	U
84	0605221F	Next Generation Aerial Refueling Aircraft	05			831,759	U
85	0605277F	CSAR-X RDT&E	05			305,062	U
86	0605278F	HC/MC-130 Recap RDT&E	05			11,692	U
87	0207434F	Link-16 Support and Sustainment	05	156,169	194,652	186,213	U
88	0207450F	E-10 Squadrons	05	351,924	39,032	42,215	Ų
89	0207451F	Single Integrated Air Picture (SIAP)	05	37,874	4,857	66,909	U
90	0207701F	Full Combat Mission Training	05	34,046	71,643	135,152	U
91	0401138F	Joint Cargo Aircraft (JCA)	05	9,781	20,869	26,777	U
92	0401318F	CV-22	05	12,756	16,583	18,562	U
93	0401845F	Airborne Senior Leader C3 (SLC3S)	05	11,700		1,992	U
	System I	Development & Demonstration		4,559,857	4,245,953	4,953,574	
94	0604256F	Threat Simulator Development	06	37,411	39,639	34,568	U
95	0604759F	Major T&E Investment	06	63,417	63,855	61,818	U
96	0605101F	RAND Project Air Force	06	33,611	30,802	28,676	U
97	0605502F	Small Business Innovation Research	06	359,706			U
98	0605712F	Initial Operational Test & Evaluation	06	34,554	30,011	29,537	υ
99	0605807F	Test and Evaluation Support	06	713,419	720,952	787,737	υ
100	0605860F	Rocket Systems Launch Program (SPACE)	06	26,503	19,023	14,895	U
101	0605864F	Space Test Program (STP)	06	48,801	47,129	48,072	U

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EXHIBIT R-1

APPRO	PRIATION: 36	00F Research, Development, Test & Eva	1, AF		:	Date: 23 JAN 20	08
Line	Program Element			Thou	sands of Dollars		S E
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	C
102	0605976F	Facilities Restoration and Modernization - Test and Evaluation Support	06	55,473	59,750	46,234	U
103	0605978F	Facilities Sustainment - Test and Evaluation Support	06	28,073	33,849	28,898	U
105	0804731F	General Skill Training	06	295			U
106	1001004F	International Activities	06	3,787	4,016	3,910	U
	RDT&E M	anagement Support		1,405,050	1,049,026	1,084,345	
107	0604263F	Common Vertical Lift Support Platform	07			3,868	U
108	0605024F	Anti-Tamper Technology Executive Agency	07	7,791	10,861	20,987	U
109	0605798F	Analysis Support Group	07				
110	0101113F	B-52 Squadrons	07	88,420	42,121	38,651	U
111	0101120F	Advanced Cruise Missile	07	6,767			U
112	0101122F	Air-Launched Cruise Missile (ALCM)	07	3,620	4,642	396	U
113	0101313F	Strat War Planning System - USSTRATCOM	07	24,774	20,130	17,553	U
114	0101314F	Night Fist - USSTRATCOM	07	4,963	5,263	5,299	U
115	0101815F	Advanced Strategic Programs	07				
116	0102326F	Region/Sector Operation Control Center Modernization Program	07	14,642	23,262	23,858	U
117	0102823F	Strategic Aerospace Intelligence System Activities	07			15	U
118	0203761F	Warfighter Rapid Acquisition Process (WRAP) Rapid Transition Fund	07	29,613	14,155	20,807	υ
119	0205219F	MQ-9 UAV	07		63,862	43,557	U

EXHIBIT R-1

Date: 23 JAN 2008

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

138 0207418F

139 0207423F

Line	Program Element	Thousands of Dollars					
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	C
							-
120	0207131F	A-10 Squadrons	07	42,491	1,951		U
121	0207133F	F-16 Squadrons	07	124,761	70,172	123,979	U
122	0207134F	F-15E Squadrons	07	134,253	114,519	184,213	U
123	0207136F	Manned Destructive Suppression	07	499		5,585	U
124	0207138F	F-22A Squadrons	07	459,464	607,515	700,305	υ
125	0207141F	F-117A Squadrons	07	11,718			U
126	0207161F	Tactical AIM Missiles	07	8,596	7,876	5,748	U
127	0207163F	Advanced Medium Range Air-to-Air Missile (AMRAAM)	07	33,411	33,425	54,239	U
128	0207170F	Joint Helmet Mounted Cueing System (JHMCS)	07	3,220	5,304	3,192	U
129	0207247F	AF TENCAP	07	11,160	11,452	11,578	U
130	0207248F	Special Evaluation Program	07	557,253			U
131	0207253F	Compass Call	07	9,586	8,549	4,670	U
132	0207268F	Aircraft Engine Component Improvement Program	07	152,969	138,159	150,956	υ
133	0207277F	CSAF Innovation Program	07	1,554			U
134	0207325F	Joint Air-to-Surface Standoff Missile (JASSM)	07	32,995	12,074	13,035	U
135	0207410F	Air & Space Operations Center (AOC)	07	74,841	100,173	118,834	υ
136	0207412F	Control and Reporting Center (CRC)	07	9,202	24,791	60,590	U
137	0207417F	Airborne Warning and Control System (AWACS)	07	157,751	151,593	126,300	U

07

2,262

38,215

Tactical Airborne Control Systems 07

Advanced Communications Systems

1,530 U

29,782 U

3,366

33,372

EXHIBIT R-1

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

Program Line Element			Thousands of Dollars				
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	c
140	00034047						-
140	0207424F	Evaluation and Analysis Program	07	2,518	646,380	794,036	U
14 1	0207433F	Advanced Program Technology	07	302,972			U
142	0207438F	Theater Battle Management (TBM) C4I	07	35,950	9,898	19,437	U
143	0207445F	Fighter Tactical Data Link	07	88,094	38,944	62,788	U
144	0207446F	Bomber Tactical Data Link	07	87,613	36,875	11,702	U
145	0207448F	C2ISR Tactical Data Link	07	4,126	1,795	1,727	U
146	0207449F	Command and Control (C2) Constellation	07	41,725	44,582	32,151	U
147	0207581F	Joint Surveillance/Target Attack Radar System (JSTARS)	07	171,628	81,978	97,641	U
148	0207590F	Seek Eagle	07	16,299	22,823	21,645	U
149	0207591F	Advanced Program Evaluation	07	584,563			U
150	0207601F	USAF Modeling and Simulation	07	22,609	22,814	28,981	U
151	0207605F	Wargaming and Simulation Centers	07	6,270	6,421	3,870	U
152	020769 7F	Distributed Training and Exercises	07	5,943	7,474	7,137	U
153	0208006F	Mission Planning Systems	07	139,217	104,575	97,560	υ
154	0208021F	Information Warfare Support	07	28,028	11,965	12,220	U
155	0208161F	Special Evaluation System	07		765,525	1,077,970	U
156	0301310F	National Air Intelligence Center	07				
157	0301314F	COBRA BALL	07				
158	0301315F	Missile and Space Technical Collection	07				
159	0301324F	FOREST GREEN	07				

160 0301386F GDIP Collection Management

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EXHIBIT R-1

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

Date:	23	JAN	2008	

Line	Program Element		Thousands of Dollars					
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	С	
162	0302015F	E-4B National Airborne Operations Center (NAOC)	07	2,728	19,406	4,069	U	
163	0303112F	Air Force Communications (AIRCOM)	07		2,009		U	
164	0303131F	Minimum Essential Emergency Communications Network (MEECN)	07	64,556	88,224	70,995	U	
165	0303140F	Information Systems Security Program	07	156,125	186,255	187,933	U	
166	0303141F	Global Combat Support System	07	22,530	11,756	4,320	U	
167	0303150F	Global Command and Control System	07	3,204	4,471	3,218	U	
168	0303158F	Joint Command and Control Program (JC2)	07	5,651	5,745	3,234	U	
169	0303601F	MILSATCOM Terminals	07	257,226	384,652	337,098	U	
170	0304111F	Special Activities	07					
171	0304260F	Airborne SIGINT Enterprise	07	119,646	135,162	173,631	υ	
172	0304311F	Selected Activities	07					
173	0304348F	Advanced Geospatial Intelligence (AGI)	07					
174	0305099 F	Global Air Traffic Management (GATM)	07	12,115	6,638	6,275	U	
175	0305103F	Cyber Security Initiative	07			2,083	U	
176	0305110F	Satellite Control Network (SPACE)	07	21,238	26,898	16,758	υ	
177	0305111F	Weather Service	07	41,676	40,959	47,347	υ	
178	0305114F	Air Traffic Control, Approach, and Landing System (ATCALS)	07	3,670	8,293	6,867	U	
179	0305116F	Aerial Targets	07	4,041	7,329	34,777	U	
180	0305124F	Special Applications Program	07					

EXHIBIT R-1

APPRO	PRIATION: 36	00F Research, Development, Test & Eva	l, AF		D	ate: 23 JAN 20	908
Line	Program Element			Thousa	ands of Dollars		S E
No 	Number	Item	Act	FY 2007	FY 2008	FY 2009	С
181	0305127F	Foreign Counterintelligence Activities	07				-
182	0305128F	Security and Investigative Activities	07	493	825	786	U
183	0305142F	Applied Technology and Integration	07				
184	0305146F	Defense Joint Counterintelligence Activities	07			39	U
185	0305159F	Defense Reconnaissance Support Activities (SPACE)	07				
186	0305160F	Defense Meteorological Satellite Program (SPACE)	07	936			U
187	0305164F	NAVSTAR Global Positioning System (User Equipment) (SPACE)	07	130,254	154,581	127,513	U
188	0305165F	NAVSTAR Global Positioning System (Space and Control Segments)	07	160,555	119,089	91,277	U
189	0305172F	Combined Advanced Applications	07				
190	0305173F	Space and Missile Test and Evaluation Center	07	2,526	3,070	1,985	U
191	0305174F	Space Warfare Center	07	703	1,667	3,003	U
192	0305182F	Spacelift Range System (SPACE)	07	45,633	27,095	12,376	U
193	0305193F	Intelligence Support to Information Operations (IO)	07	1,290	5,927	1,237	U
195	0305206F	Airborne Reconnaissance Systems	07	51,842	64,441	149,752	U
196	0305207F	Manned Reconnaissance Systems	07	37,015	21,387	12,819	U
197	0305208F	Distributed Common Ground/Surface Systems	07	124,007	107,048	107,834	U
198	0305219F	MQ-1 Predator A UAV	07	77,885	33,781	24,773	U
199	0305220F	Global Hawk UAV	07	224,126	274,742	284,292	U
DEPARTMENT OF THE AIR FORCE FY 2009 RDT&E PROGRAM

EXHIBIT R-1

Date: 23 JAN 2008

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

Line	Program Element			Tì	nousands of Dollars		S
No	Number	Item	Act	FY 2007	FY 2008	FY 2009	E C -
200	0305221F	Network-Centric Collaborative Targeting	07	18,466	8,586	8,807	U
201	0305265F	GPS III Space Segment	07			420,342	U
202	0305887F	Intelligence Support to Information Warfare	07	5,121	5,305	5,438	U
203	0305906F	NCMC - TW/AA System	07	42,152	11,720		U
204	0305913F	NUDET Detection System (SPACE)	07	59,917	38,279	41,292	U
205	0305924F	National Security Space Office	07	17,351	10,745	10,797	U
206	0305940F	Space Situation Awareness Operations	07	29,476	23,827	16,166	U
207	0307141F	Information Operations Technology Integration & Tool Development	07	14,759	15,582	15,726	U
208	0308699F	Shared Early Warning (SEW)	07	2,896	3,127	3,152	U
209	0401115F	C-130 Airlift Squadron	07	185,554	250,020	172,560	U
210	0401119F	C-5 Airlift Squadrons (IF)	07	137,565	178,990	125,063	U
211	0401130F	C-17 Aircraft (IF)	07	170,527	180,581	236,047	U
212	0401132F	C-130J Program	07	34,765	73,753	52,354	U
213	0401134F	Large Aircraft IR Countermeasures (LAIRCM)	07	35,349	19,201	32,100	U
214	0401218F	KC-135s	07	1,092	8,710	7,133	U
215	0401219F	KC-10s	07	4,696	13,703		U
216	0401221F	KC-135 Tanker Replacement	07	68,340	113,728		U
217	0401314F	Operational Support Airlift	07		4,837		U
218	0401839F	Air Mobility Tactical Data Link	07	6,785			U
219	0408011F	Special Tactics / Combat Control	07	1,962	8,074	5,728	U
220	0702207F	Depot Maintenance (Non-IF)	07	1,411	1,501	1,531	U

DEPARTMENT OF THE AIR FORCE FY 2009 RDT&E PROGRAM

EXHIBIT R-1

Date: 23 JAN 2008

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

	Program			Thou	sands of Dollars		s
No	Element Number	Item	Act	FY 2007	FY 2008	FY 2009	Е С
221	0702806F	Acquisition and Management Support	07	26,645	22,141	34,428	U
222	0708011F	Industrial Preparedness	07	65,543	50,186		U
223	0708012F	Logistics Support Activities	07	2,132			U
224	0708610F	Logistics Information Technology (LOGIT)	07	90,557	114,599	189,679	U
225	0708611F	Support Systems Development	07	23,651	33,859	8,145	U
226	0804757F	Joint National Training Center	07	2,964	3,108	3,214	U
227	0808716F	Other Personnel Activities	07	110	114	116	υ
228	0901202F	Joint Personnel Recovery Agency	07	960	5,342	5,768	υ
229	0901212F	Service-Wide Support (Not Otherwise Accounted For)	07		6,454	3,016	U
230	0901218F	Civilian Compensation Program	07	13,160	8,019	8,123	U
231	0901220F	Personnel Administration	07	18,787	16,714	18,625	U
232	0901538F	Financial Management Information Systems Development	07	25,408	36,836	31,782	υ
	Operatio	onal Systems Development		13,506,529	15,826,555	17,513,504	
	Total Researd	ch, Development, Test & Eval, AF		24,491,745	26,069,228	28,066,617	

xxxiv

PROGRAM ELEMENT COMPARISON SUMMARY

PROGRAM ELEMENT (By BUDGET ACTIVITY)

BUDGET ACTIVITY #1: BASIC RESEARCH (V	olume 1)	REMARKS		
BUDGET ACTIVITY #2: APPLIED RESEARCH	l (Volume 1)			
BUDGET ACTIVITY #3: ADVANCED TECHNOI	LOGY DEVELOPMENT (Volume 1)			
0603216F	Aerospace Propulsion and Power Technology	In FY 09, funding is higher to support ground demonstrations and fabrication of test vehicles for flight demonstrations. The funding in this project has been increased due to emphasis on component development in support of adaptive cycle technologies alternative hydrocarbon jet fuel, and improved fuel efficiency.		
0603680F	Manufacturing Technologies	In FY 09, the AF Manufacturing Technologies program will transfer to PE 0603680F, Manufacturing Technologies, from PE 0708011F, Industrial Preparedness, to focus on long-term manufacturing and processes.		
BUDGET ACTIVITY #4: ADVANCED COMPON	ENT DEVELOPMENT AND PROTOTYPE (Volume 2)			
0604796F	Alternative Fuels Operationally Responsive Space	In FY 09, PE 0604796F is a new PE. Previous alternative fuels work was accomplished in the "RDT&E for Aging Aircraft" PE (0605011F). In FY 09, Project 64A020, AF-funded ORSSats is being established to identify the funding the Air Force is planning to use for Air Force projects to meet ORS requirements. Project 64A015 is renamed ORS Common Services from Tactical Satellites. This is to delineate the funding the Air Force is contributing to support the overall DoD ORS effort versus the funding the Air		
0604857F		Force is using to pursue specific Air Force ORS projects.		
BUDGET ACTIVITY #5: SYSTEM DEVELOPME	ENT AND DEMONSTRATION (SDD) (Volume 2)			
0207450F	E-10 Squadrons	In FY09,The Global Hawk (GH) MP-RTIP sensor development continues in the sensors project line.The E-10 program was terminated in FY08.		
0207451F	Single Integrated Air Picture (SIAP)	In FY09, Project 5275, Joint SIAP System Engineering and Development efforts were transferred from Army PE 0603327A - Air and Missile Defense Systems Engineering, Project S32, Joint SIAP System Engineering, into Air Force PE 0207451F in accordance with DoD designation of the Air Force as the SIAP Acquisition Executive. These funds support the research, development and testing of the Integrated Architecture Behavior Model (IABM), conduct Joint System-of -Systems Engineering for air and cruise missile defense, and operation of the SIAP Joint Program Office (SIAP JPO) and SIAP Joint Program Executive Office (SIAP JPEO).		
0604261F	Personnel Recovery Systems	In FY09, the CSAR-X and HC-130Recap projects separate into distinct PEs (0605277F and 0605278F, respectively) to provide more budget clarity. Procurement funding for CSAR-X remains in PE 0207224F and is reported in P-Docs. Procurement funding for HC/MC-130 Recap is included in Air Combat Command PE 0207224F and Air Force Special Operations Command PE 0207230F, as reported in P-Docs.		

0604617F	Agile Combat Support	In FY09, \$3.5M was transferred to PE 0603112F, Advanced Materials for Weapon Systems, to support technology evaluation for Airfield Damage Repair (ADR) and Rapid Parking Ramp Expansion (RPRE)
		In FY09, \$239.8M in Transfer Fund. These transfer funds will be used to fund KC-X acquisition after
0605221F	KC-X, Next Generation Aerial Refueling Aircraft	contract award.
0605277F	CSAR-X	In FY09, CSAR-X is in this new PE to provide more budget clarity.

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

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

0401221F	KC-135 Replacement Tanker	In FY 09, \$239.8M in Transfer Fund. These transfer funds will be used to fund KC-X acquisition after contract award.
0604263F	CVLSP	In FY 09, Project Number 5277, CVLSP, includes new start efforts
0708011F	Industrial Preparedness	In FY09, the program will transfer from PE 0708011F, Industrial Preparedness, to Budget Activity 3 in PE 0603680F, Manufacturing Technologies, to better align with the Office of the Secretary of Defense's ManTech PE.

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

Title No. Night Fist 0101314F 0101815F Advanced Strategic Program 0207248F Special Evaluation Program 0207424F Evaluation and Analysis Program Advanced Program Technology 0207433F 0207591F Advance Program Evaluation 0208161F Special Evaluation System National Air Intelligence Center 0301310F 0301314F COBRA BALL Missile and Space Technical Collection 0301315F 0301324F FOREST GREEN 0301386F GDIP Collection Management 0301555F Classified Programs Special Program 0301556F 0304111F Special Activities 0304311F Selected Activities 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 0603801F Special Programs 0605798F Analysis Support Group

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.

PE NUMBER: 0601102F PE TITLE: Defense Research Sciences

	Evhik			t Itom lust	ification			DATE		
	Exhibit R-2, RDT&E Budget item Justification								February	2008
BUDGE	T ACTIVITY			PE	E NUMBER AND	TITLE				
01 Bas	aic Research			0	601102F Defe	ense Researd	ch Sciences			
	Cost (\$ in Millions)	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	Complete	
	Total Program Element (PE) Cost	271.481	288.601	309.926	322.878	340.227	344.120	349.097	Continuing	TBD
2301	Physics	27.729	49.482	46.988	47.496	49.068	48.505	48.834	Continuing	TBD
2302	Solid Mechanics and Structures	16.463	16.926	18.028	19.936	20.378	20.348	19.797	Continuing	TBD
2303	Chemistry	33.523	33.562	38.233	38.420	39.532	39.591	39.508	Continuing	TBD
2304	Mathematics and Computing Sciences	30.165	24.135	30.586	33.430	36.027	36.373	37.994	Continuing	TBD
2305	Electronics	34.245	32.963	39.289	40.943	43.636	43.689	43.502	Continuing	TBD
2306	Materials	39.054	37.436	25.681	25.118	26.659	27.335	27.633	Continuing	TBD
2307	Fluid Mechanics	13.576	14.366	18.486	20.812	22.467	23.080	23.199	Continuing	TBD
2308	Propulsion	20.499	21.144	25.432	25.732	26.956	27.431	27.847	Continuing	TBD
2311	Information Sciences	26.008	25.257	31.640	32.512	36.241	38.062	39.045	Continuing	TBD
2312	Biological Sciences	9.682	10.332	10.473	10.601	10.444	10.230	10.120	Continuing	TBD
2313	Human Performance	12.161	11.052	15.255	18.065	19.220	19.538	21.299	Continuing	TBD
4113	External Research Programs Interface	8.376	11.946	9.835	9.813	9.599	9.938	10.319	Continuing	TBD

Note: In FY 2007, Project 2311 "Space and Information Sciences" changed its name to "Information Sciences" changed its name to "Information Sciences." In FY 2008, Space related efforts in Project 2311 and Physical Mathematics efforts in Project 2304 were moved into Project 2301 in this program element (PE) to more accurately align basic research efforts in Physics.

(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 2008, Congress added \$0.8 million for Chabot Space and Science Center, \$5.0 million for High Energy Laser for Detection, Inspection and Non-Destructive Testing, \$2.0 million for Nanotechnology Based Biosensors and Biothreat Detectors, \$0.7 million for UNR (University of Nevada-Reno) - Millimeter Wave-Based Fatigue Countermeasure Technology, \$1.6 million for Fully-Integrated Solar-Powered Interior Lighting Technology, \$1.0 million for Process Integrated Mechanism for Human-Computer Collaboration and Coordination, \$1.6 million for Hybrid Materials for Thermal Management in Thin Films and Bulk Composites, \$16.0 million for National Aerospace Leadership Initiative, \$2.4 million for Development and Validation of Advanced Design Technologies for Hypersonic Research, and \$1.0 million for Coal Transformation Laboratory. 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 49	Exhibit R-2 (PE 0601102F)
1	
UNCLASSIFIED	

	Exhibit R-2, RDT&E Bu	DATE Februa	DATE February 2008	
BUD(01 E	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences		•
(U)	B. Program Change Summary (\$ in Millions)			
		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	Previous President's Budget	281.156	258.259	263.012
(U)	Current PBR/President's Budget	2/1.481	288.601	309.926
(\mathbf{U})	l otal Adjustments	-9.675	30.342	
(0)	Congressional Program Reductions		-0.018	
	Congressional Increases		-1./40	
	Congressional increases	2 672	16,000	
	SPID/STTD Transfor	-5.072	10.000	
an	Significant Program Changes	-0.005		
(0)	Not Applicable			
	Tot Applicable.			
	C. Performance Metrics			
	(U) Under Development.			
	(c)			
		K-1 Line Item No. 1 Page-2 of 49	Fxhihit F	R-2 (PE 0601102E)
L		2		(1 = 00011021)

	Ext	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDO 01 B	GET ACTIVITY asic Research			P 0 5	PE NUMBER AND 1601102F Def 160iences	TITLE ense Resear	ch	PROJECT NUME 2301 Physics	BER AND TITLE S	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2301	Physics	27.729	49.482	46.988	47.496	49.068	48.505	48.834	Continuing	TBD
Note	Quantity of RD1&E Articles	U 211 and Dhysia	0 al Mathamatia	U U	1 0	U U	U Viant in EV 200	0	anotaly alian ha	
rosoa	rch efforts in Physics	2511 and Physic	ai Mathematic	s errorts from r	Project 2504 mo	oved to this Pro	oject ill F I 200	be to more accu	aratery angli ba	SIC
(U)	A. Mission Description and Budget Item Physics basic research seeks to enable revo capabilities, communications and navigation research investigated by this project are lass and imaging physics; space environment p	LJustification olutionary advar onal systems, fu ser and optical p hysics; electron	nces in and exp els and explosi hysics; electro hagnetics; and a	and the fundan ves, and direct -energetics (ind applied analysi	nental knowled ed energy wear cludes plasma) s.	ge supporting l oons that are cri physics; atomic	aser technolog itical to the Air c, molecular, a	ies, sensing and r Force. The pri nd particle phys	l imaging mary areas of sics; space sens	ors
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Investigate regulated adaptive optics.	(\$ in Millions) , broad-spectru	n, variable-ene	ergy lasers, lase	er arrays, and m	ulti-aperture	<u>FY</u>	<u>7 2007</u> 9.274	<u>FY 2008</u> 9.418	<u>FY 2009</u> 10.609
(U)	In FY 2007: Investigated new laser mater wavelength tunable lasers. Investigated an intense light source applications. Explored techniques that offer new microsystems far nonlinear optical devices for improved ap In EV 2008: Study mechanical optical a	rials and config rrays of micro-d d use of directed abrication and p pplication to infr	urations to enal ischarges for la l energy beams ackaging capal ared countermises of ceramic	ble efficient, hi aser devices an s for direct-writ bilities. Studiec easures. materials as a t	igh power, and d pumps, as we te materials pro d semiconducto function of mat	wide Il as other cessing r laser and erial and				
(0)	preparation parameters. Investigate novel ceramic lasing. Study means for efficientl crystals for tunable high energy lasing. St temperature operation of mid-infrared sen missile countermeasures.	l index, gain and ly producing and udy fundamenta niconductor lase	l doping profil l making avail l and practical ers, which have	es for high pow able quasi-phas limitations on e shown great p	ver, high beam, se matched sem efficiency and promise for heat	quality iconductor high t seeking				
(U)	In FY 2009: Investigate applications of p array ultraviolet sources to large flexible of disease treatment. Continue and expand ro micro-systems, including on-board power inexpensive, flexible subsystems for space	revious researcl displays, materi esearch on high r sources. Apply e.	n enabling larg als curing, biol energy, tunabl 3-D laser writ	e inexpensive, ogical agent de e, all solid state e techniques in	very bright mic econtamination, e lasers. Study o a special glasses	ro-plasma , and infectious direct-write s to				
(U) (U)	MAJOR THRUST: Explore high-energy	, electro-energe	ic device conc	epts and manip	pulate atomic ar	nd molecular	1	13.097	13.162	14.353
Proj	ect 2301			R-1 Line Ite Page-3 c	m No. 1 of 49				Exhibit R-2a (I	PE 0601102F)

	Exhibit R-2a, RDT&E Project	February	/ 2008			
BUD(01 E	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2301 Phy	UMBER AND TITLE SICS	R AND TITLE	
(U)	B. Accomplishments/Planned Program (\$ in Millions) properties, atomic collision processes, and atomic, molecular, ionic, and radiat and fuels, advance directed energy systems, enhance surveillance, provide sup- precision navigation.	ion interactions to improve explosives erior communications, and improve	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Characterized the interactions of atoms and molecules in strong et techniques for precision measurement of atomic and molecular properties, ator fundamental interactions between atoms, molecules, ions, and radiation. Explo combustion and high energy density propellants. Studied electro-energetic con Explored high power, high frequency electromagnetic device concepts and studie technologies. Explored use of electron beam generated microwaves for high-ballong-distance covert surveillance, electronic countermeasures, and directed energy current density cathode concepts. Initiated advanced modeling and simulation Studied overlapped research areas between atomic physics and condensed matri issues blocking realization of electromagnetic launch concepts.	electromagnetic fields. Examined nic collision processes, and ored dynamic molecular interactions in cepts related to non-lethal weaponry. dies of new compact pulsed power andwidth communications, advanced ergy weapons. Investigated ultra-high of electro-energetic phenomena. ter physics. Resolved basic scientific				
(U)	In FY 2008: Explore usage of ultra-cold atoms and molecules for precision ind and ultra-precise measurement techniques using the results of previous researce fundamental interactions between atoms, molecules, ions, and radiation. Explo materials using the results of research in the overlap between atomic physics at exploring new concepts for high-power, high-frequency electromagnetic radiate effects relating to the emission of electrons from surfaces. Examine the applicate fundamental limits on electrical energy storage density. Study the seamless into particle-in-cell modeling algorithms to better capture the detailed physics of high- physics of high-power is the seamless of high-particle-in-cell modeling algorithms to better capture the detailed physics of high-particle-in-cell modeling algorithms to better capture the detailed physics of high-particle-in-cell modeling algorithms to better capture the detailed physics of high-particle-in-cell modeling algorithms to better capture the detailed physics of high-particle-in-cell modeling algorithms to better capture the detailed physics of high-particle-in-cell modeling algorithms to better capture the detailed physics of high-particle-in-cell modeling algorithms to be the capture the detailed physics of high-particle-in-cell modeling algorithms to be the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of high-particle-in-cell model of the capture the detailed physics of the capture the detailed physics of the capture the detailed physics of the capture the capture the capture the capture the capture the capture the captu	ertial navigation system components h into atomic collision processes and re the possibility of tailor-making nd condensed matter physics. Continue tion sources. Study quantum physics ation of Chaos Theory effects to raise egration of magnetohydrodynamic and gh power microwaye sources.				
(U)	In FY 2009: Continue studying the usage of ultra-cold atoms and molecules for components and ultra-precise measurement techniques using the results of prev processes and fundamental interactions between atoms, molecules, ions, and ra possibility of tailor-making materials using the results of research in the overla condensed matter physics. Exploit emerging microfabrication methodologies f high-frequency, high-power electromagnetic radiation sources. Continue study electron emission from surfaces. Expand Chaos Theory studies to raise fundam storage density. Create new simulation codes embodying both magnetohydrody to realistically model high power microwave sources.	or precision inertial navigation system vious research into atomic collision adiation. Continue exploring the up between atomic physics and or the realization of compact, ing quantum effects impacting nental limits on electrical energy ynamic and particle-in-cell algorithms				
(U)						
Pro	ect 2301	1 Line Item No. 1 Page-4 of 49		Exhibit R-2a	(PE 0601102F)	

4

	Exhibit R-2a, RDT&E Project Justific	DA	February	/ 2008	
BUD(01 E	GET ACTIVITY PE casic Research 06 So	NUMBER AND TITLE 001102F Defense Research ciences	PROJECT N 2301 Phys	UMBER AND TITLE SICS	
(U)	B. Accomplishments/Planned Program (\$ in Millions)	d for a live and the design d	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	effective space situational awareness.	id tracking methods, and	4.008	4.080	5.8/1
(U)	In FY 2007: Studied fundamental issues that affect remote sensing, including propagati image recovery processes. Identified, characterized, and modeled parameters enabling r precision tracking of objects, particularly from space and of space objects from the grou effects on sensors and sensor systems and of the effects of the medium through which the	on, image formation, and emote sensing, locating, and and. Studied environmental ne signal propagates.			
(U)	In FY 2008: Develop theoretical approaches to the surveillance and identification of sp ground and from space. Continue to study propagation of electromagnetic energy, imag and information content maximization from both ground-based and space-based sensors mitigate environmental effects on sensors and sensor systems. Investigate atmospheric of improve satellite orbit determination and tracking	ace objects from both the e formation, image recovery, s. Investigate methods to lensity forecast models to			
(U)	In FY 2009: Continue to investigate fundamental limits affecting ground-based and spa space objects. Develop improved adaptive optics and post-processing techniques for im Study spectral, polarimetric, and temporal approaches to unresolved space object identify of fundamental processes in the solar-terrestrial system that affects atmospheric density methods of satellite orbit prediction and precision tracking	ce-based surveillance of proved image resolution. fication. Continue the study to lead to physics-based			
(U)	includes of satellite of of prediction and precision tracking.				
(U)	MAJOR THRUST: Research space environment to improve solar plasma theories and a phenomena, space weather, magneto/ionosphere effects, space debris, adaptive optics for observation, better space-based communications, and the quantifying of risks to space space Environment efforts previously in Project 2311 in this PE were moved into this P align basic research efforts in Physics.	modeling in the areas of solar or improved space ystems. Note: In FY 2008, troject to more accurately	0.000	4.919	6.110
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Begin using newly developed radio telescope instruments to probe the near study solar phenomena, and to develop innovative methods for remote sensing the space heliospheric tomography. Investigate fundamental plasma modeling theory using new g techniques, and develop novel techniques to include electromagnetism. Continue develop space-based sensor technology for remote sensing and in situ measurement of space we seek understanding of fundamental physics and processes controlling solar, heliospheric ionospheric, and thermospheric environments with a focus on improving forecast capab environment using first principles physics models. Continue developing understanding of	r-Earth space environment, to e environment as well as for rid-free, full kinetic modeling opment of ground-based and ather conditions. Continue to e, magnetospheric, ilities of the near-Earth space of fundamental processes of			
Pro	R-1 Line Item Page-5 of	No. 1 49		Exhibit R-2a	(PE 0601102F)
0	5	-			(<u> </u>

	Exhibit R-2a, RDT&E Project Jus	DA	TE February	/ 2008	
BUDGET / 01 Basi	ACTIVITY c Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2301 Phys	UMBER AND TITLE SiCS	
(U) <u>B.</u> end sol sun neu	<u>Accomplishments/Planned Program (\$ in Millions)</u> ergetic particle scattering in the near-Earth environment to support protection of s lar interior as a complex system through advanced modeling techniques. Continue rveillance satellites to improve remote sensing of interplanetary space. Maintain f eutral densities and winds above 150 kilometers.	space assets and to explore the e to analyze data from DoD focused research to investigate the	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In rec rac fur en ph gri for fur ass ana	FY 2009: Emphasize development of cost - effective micro satellites for space we quirements of boundary conditions and initial values for driving space weather mo- dio astronomy techniques for remote sensing the space environment in the continu- ndamental physics and processes controlling solar, heliospheric, magnetospheric, vironments with a focus on improving our ability to forecast near-Earth space envi- sysics models. Expand investigation of the fundamental plasma modeling theory u- id-free, full kinetic modeling techniques. Continue ground-based and space-based r remote sensing and in situ measurement of space weather conditions. Continue of ndamental processes of energetic particle scattering in the near-Earth environmen sets and to explore the solar interior as a complex system through advanced mode alyze data from DoD surveillance satellites to improve remote sensing of interpla	veather sensing. Investigate odels. Exploit newly developed ned search for understanding of ionospheric, and thermospheric vironment using first principles using new electromagnetic, sensor technology development developing understanding of t to support protection of space ling techniques. Continue to netary space. Maintain focused			
(U) (U) M des op mo	AJOR THRUST: Research physical mathematics and applied analysis to develop enomena to enhance the fidelity of simulation. Conduct research in electromagne escriptions of electromagnetic properties of novel materials/composites and simula perational settings. Note: In FY 2008, Physical Mathematics efforts previously in oved into this project to more accurately align basic research efforts in Physics.	o accurate models of physical tics to produce conceptual ate their uses in various Project 2304 in this PE were	0.000	8.854	10.045
(U) In (U) In atr to em tra the inv tog	FY 2007: Not Applicable. FY 2008: Continue to investigate properties of coherently propagating ultra-shor mosphere with an emphasis on their ability to propagate through clouds and be use develop algorithms to simulate nonlinear optical effects within fiber lasers and no aphasis on designs for 199KW laser weapons. Continue to investigate the dynami- unsonic/supersonic/hypersonic platforms, with an emphasis on stores release. Mode e upper atmosphere on the stability of high altitude platforms as well as to assure ventory. Study the design of reconfigurable warheads through suitable timing/plac gether with effects of metal particle inclusions. Continue to improve methods for	rt laser pulses through the ed for target imaging. Continue onlinear optical media with an cs of lel the effects of the dynamics of the effective uses of their optical cement of micro-detonators, recognizing and tracking targets			
Project 2	2301 R-1 Line Page	Item No. 1 -6 of 49		Exhibit R-2a	(PE 0601102F)

	Exhibit R-2a, RDT&E Project Justifi	cation	DA	TE February	2008
BUD(01 E	GET ACTIVITY PE Basic Research 00 S	E NUMBER AND TITLE 601102F Defense Research ciences	PROJECT N 2301 Phys	UMBER AND TITLE	
(U)	B. Accomplishments/Planned Program (\$ in Millions) and for penetrating coverings or other dispersive media that obscure targets so that rada can be used to image through foliage and clouds. Pursue the design of electromagnetic so of novel materials, can transmit optimized waveforms for a variety of surveillance purp	r emitting suitable waveforms sources which, with the help oses.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Investigate properties of coherently propagating ultra-short laser pulses the their exploitation as high power microwave sources. Upgrade algorithms to simulate not fiber lasers and nonlinear optical media so that simulation of various lasers can be realized modeling/simulation effort to codify the theoretical work on the dynamics of transonic/platforms to verify that designs and operations are near optimal. Model the effects of the atmosphere on the stability of high altitude platforms, as well as to assure the effective inventory. Communicate these results to the airborne laser program and to the Air Force the latter's high altitude platforms. Verify the design of reconfigurable warheads throug of micro-detonators, as well as the effects of various metal inclusions on lethality. Contrecognizing and tracking targets and for penetrating coverings or other dispersive media the design of electromagnetic sources which, with the help of novel materials, can trans a variety of surveillance purposes and write numerical code which allows the user to sin	rough the atmosphere for onlinear optical effects within zed. Initiate a supersonic/hypersonic e dynamics of the upper uses of their optical e's Air Combat Command, for h suitable timing/placement inue to improve methods for a that obscure targets. Pursue mit optimized waveforms for nulate these sources.			
(U) (U) (U)	CONGRESSIONAL ADD: Non-Lethal Stunning/Immobilizing Weapons In FY 2007: Accelerated fundamental scientific investigations in non-lethal stunning an	nd immobilizing weapons	0.750	0.000	0.000
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Chabot Space and Science Center In FY 2007: Not Applicable. In FY 2008: Develop new science programs for K-12 students, teachers, and the genera In FY 2009: Not Applicable.	l public.	0.000	0.795	0.000
(U) (U) (U) (U)	CONGRESSIONAL ADD: High Energy Laser for Detection, Inspection and Non-Dest In FY 2007: Not Applicable. In FY 2008: Conduct laser technology research to support multiple applications, include hardware and equipment flaws, and detecting weapons hidden in cargo ships.	ructive Testing	0.000	4.970	0.000
Pro	ect 2301 R-1 Line Iten	n No. 1 f 49		Exhibit R-2a	(PE 0601102F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD(01 E	GET ACTIVITY Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences			PROJECT NUMBER AND TITLE 2301 Physics		
(U) (U)	B. Accomplishments/Planned Pl In FY 2009: Not Applicable.	rogram (\$ in Mil	<u>lions)</u>				I	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U)	CONGRESSIONAL ADD: Nanot In FY 2007: Not Applicable. In FY 2008: Research to remotely tools while performing new nanot trained in nanotechnology research	technology Based control the opera related science fie h area.	l Biosensors and ation of both nar eld. In addition,	l Bio-Threat Den nofabrication eq a significant nu	tectors uipment and nan mber of minority	oscale analysis y engineers will	be	0.000	1.988	0.000
(U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: UNR In FY 2007: Not Applicable. In FY 2008: Develop a novel devi countermeasure for use in the batt	- Millimeter Wav ice based on milli lefield.	ve-Based Fatigu meter wave tecl	e Countermeasu nnology that wil	re Technology l serve as a skele	etal muscle fatig	ue	0.000	0.696	0.000
(U) (U)	In FY 2009: Not Applicable. Total Cost							27.729	49.482	46.988
(U) (U) (U) (U) (U) (U)	Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602204F, Aerospace Sensors. PE 0602500F, Multi-Disciplinary Space Technology. PE 0602601F, Space Technology. PE 0602605F, Directed Energy Technology.	FY 2007 Actual	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>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Pro	ject 2301			R-1 Lin Pag	e Item No. 1 e-8 of 49 8				Exhibit R-2a	(PE 0601102F)

Exhibit R-2	DATE February 2008	
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2301 Physics
(U) D. Acquisition Strategy Not Applicable.		
	R-1 Line Item No. 1	
Project 2301	Page-9 of 49	Exhibit R-2a (PE 0601102F)

	Ext	nibit R-2a, F	DT&E Pro	ject Justifi	ication			DATE	February	2008	
BUDGE 01 Ba	ET ACTIVITY Isic Research			P 0 S	PE NUMBER AND TITLEPRO0601102F Defense Research230Sciences			PROJECT NUMB 2302 Solid Me	DJECT NUMBER AND TITLE 02 Solid Mechanics and Structures		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
2302	Solid Mechanics and Structures	16.463	16.926	18.028	19.936	20.378	20.348	19.797	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
S p s a ti n	Solid mechanics and structures basic resear obtained by the structures basic research afe, reliable operation of superior Air Force actuators, and control systems integrated to the modeling of non-linear static/dynamic bano-materials; and composite materials for	rch aims to import rmation and fract ce weapon and co accomplish dat behavior of stru- or structures.	ove load-beari ture of materia lefensive syste mage control, t ctures; mechan	ing performanc als to the struct ms. Fundamer thermal manago nical reliability	e of air and spa ural dynamics of ntal knowledge ement, vibration of micro-device	ce structures th of large platforn of "multi-funct n reduction, and es; design of m	rough the pred ns. The goals ional" structure l reconfigurabl ulti-functional	liction and cont are cost-effectiv es with smart m le shapes. Rese materials; mecl	rol of multi-sca ve developmen laterials, sensor arch topics inc hanical behavio	ale t and rs, lude: or of	
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Explore the integratio turbine engines, air vehicles, space system system integration. In FY 2007: Expanded research in the are autonomics, thermal management, atomic aerospace structures with improved perfor	(\$ in Millions) on of advanced as, and other we eas of diagnostic -scale modeling rmance characte	materials (inclu apon systems, es, prognostics, , and energy h ristics. Develo	uding nano-ma and develop ne , self-healing, r arvesting to en ped the fundan	terials) and dev ew mechanics c nicro-/nano-me able safer and n nental knowleds	ices into riteria for chanics, nore durable ge required to	<u>FY</u>	<u>2007</u> 7.773	<u>FY 2008</u> 8.027	<u>FY 2009</u> 8.578	
(U)	and structural integrity. Developed and ex design of new material systems and device In FY 2008: Expand research in the area functions of broad bandwidth and improve prognostics, autonomics, self-healing, the to enable safer and more durable aerospac	ploited methods es at multiple so of multi-functio ed structural enor rmal manageme es structures wit	al systems and that combine ales. nal composite lurance. Conti nt, energy harv h improved per	information ter systems with s inue research in vesting/storage. rformance char	tructurally integ tructurally integ the areas of di and micro-/nar acteristics. Furt	agnostics, hor mechanics her develop					
(U)	the fundamental knowledge required to de devices and to predict their performance a combine information technology and mult In FY 2009: Continue research in the area neutralization of exogenous threats to load prognostics, autonomics, self-healing, the radiation/transmission, and micro-/nano-n	esign and manuf and structural in ti-scale modelin a of multi-funct d-bearing capab rmal manageme mechanics to ena	acture multi-fu egrity. Conting g in the design onal hybrid co ility. Continue nt, energy harv ble safer and r	unctional aeros ue developing a of new materi omposite system research in the vesting/storage more durable ae	pace material sy and exploiting r al systems and ns for sensing a e areas of diagno , electromagnet erospace structu	vstems and nethods that devices. nd ostics, ic energy ures with					
Proje	ct 2302			R-1 Line Iter Page-10 10	m No. 1 of 49				Exhibit R-2a (I	PE 0601102F)	

	Exhibit R-2a, RDT&E Project J	lustification	D/	February	/ 2008
BUD(01 E	ET ACTIVITY asic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2302 Soli	UMBER AND TITLE d Mechanics ar	d Structures
(U)	B. Accomplishments/Planned Program (\$ in Millions) improved performance characteristics. Further develop the fundamental knowle manufacture multi-functional aerospace material systems and devices and to pre- integrity. Continue developing and exploiting methods that combine informatio modeling in the design of new material systems.	dge required to design and edict their performance and structural n technology and multi-scale	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Analyze structural fatigue and mechanics, adaptive structur improve the design, robustness, and performance of air and space systems to invehicles (UAVs).	8.690	8.899	9.450	
(U)	In FY 2007: Explored novel methods for constructing and modeling morphing operational capabilities. Developed novel actuation devices and materials for an aircraft and space structures. Utilized acquired knowledge of material behavior system lifetime prognosis methodologies. Developed structural health monitoric exploration of mechanical and dynamic behavior of micro-/nano-scale structure such as structural deformation and aero-elastic effects in novel structural applic	structures that broaden system oplications such as micro-UAV in aerospace structure to develop ng techniques and systems and s. Investigated nonlinear phenomena, ations			
(U)	In FY 2008: Develop novel theoretical and experimental methods for construct structures that broaden system operational capabilities. Continue development of materials for a variety of Air Force applications to aircraft and space structures, the introduction into new structural concepts of the novel materials developed up programs. Use the knowledge acquired about the novel materials to develop new Develop an integrated approach to structural systems lifetime prognosis. Contin health monitoring sensors and techniques towards an integrated vehicle-wide ap of mechanical and dynamic behavior of micro-/nano-scale structures. Expand the phenomena associated with the structural deformation and aero-elastic instability include novel structural concepts.	ing and modeling morphing of novel actuation devices and Study the science issues related to under the advanced materials w aerospace structural concepts. ue the development of structural oproach. Consolidate the exploration he investigation of nonlinear ties and limit-cycle vibration to			
(U)	In FY 2009: Expand the novel theoretical and experimental methods in morph broader operational capabilities. Utilize novel actuation devices and materials for structural applications. Expand the study of the science related to the acceptance materials developed under the advanced materials programs. Use this acquired structural concepts. Continue the development of structural health monitoring s- integrated vehicle-wide approach. Consolidate an integrated approach to structu- reliability. Expand the understanding of mechanical and dynamic behavior of m	ing aircraft structures to achieve or Air Force aircraft and space e into new structures of the novel knowledge to develop new aerospace ensors and techniques towards an ural systems lifetime prognosis and hicro-/nano-scale structures to			
Pro	ect 2302 F	Line Item No. 1 Page-11 of 49		Exhibit R-2a	(PE 0601102F)
		11			

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD 01 E	GET ACTIVITY Basic Research				PE NUMBER AND TITLE 0601102F Defense Research Sciences			PROJECT NUMBER AND TITLE 2302 Solid Mechanics and		d Structures
(U) (U)	B. Accomplishments/Planned Pr generate novel structural concepts deformation and aero-elastic instal Total Cost	ogram (\$ in Mil . Continue invest bilities and limit-	llions) igation of nonlin cycle vibration	near phenomena to include novel	associated with structural conce	the structural epts.	Ē	<u>Y 2007</u> 16.463	<u>FY 2008</u> 16.926	<u>FY 2009</u> 18.028
	C. Other Program Funding Summ Related Activities: PE 0602102F, Materials. PE 0602201F, Aerospace Flight Dynamics. PE 0602202F, Human Effectiveness Applied Research. PE 0602203F, Aerospace Propulsion. PE 0603211F, Aerospace Structures. D. Acquisition Strategy Not Applicable.	mary (\$ in Milli FY 2007 Actual	ons) FY 2008 Estimate	<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	<u>Total Cost</u>
Pro	ject 2302			R-1 Lin Page	e Item No. 1 ⊶12 of 49 12				Exhibit R-2a	(PE 0601102F)

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUD(01 E	GET ACTIVITY Basic Research			P 0 S	PE NUMBER AND TITLE PR 0601102F Defense Research 23 Sciences			PROJECT NUMBER AND TITLE 2303 Chemistry		
		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ 11 Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
230	3 Chemistry	33.523	33.562	38.233	38.420	39.532	39.591	39.508	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	Chemistry basic research seeks bold innova existing materials, controlling energy flow understanding of properties regulating the of infrared, optical, and radar signatures of rea novel synthesis and characterization of low electromagnetics; and conventional weapon exploration of atomic and molecular surface research include molecular reaction dynam	ations in unders and storage, an chemical dynan action products ver cost, higher nry. Focused in the interactions the ics; theoretical	tanding, model d regulating in nics and energy and intermedia performance fu vestigations ind nat limit perfor chemistry; poly	ling, and contro teractions betw / transfer proce ates that advance unctional and st clude bio-derive mance of electry ymer chemistry	olling chemical even materials a ssess that foster ce reliable targe tructural materia ed mechanisms ronic devices, c y; biophysical m	reactions for de nd their environ advances in las et assessment ar als, electronics, for lifetime ex compact power nechanisms; and	eveloping new nments. Studie er weaponry a nd tracking. Cr , and photonic tension of mat sources, and lu d surface and i	materials, imprese expand funda and allow predict itical research to materials; nano erials and cataly ubricant materia nterfacial scien	roving synthesis mental ctions of the opics include: o-structures; ysis, and the ils. Primary area ce.	s of as of
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Research and charact chemistry to model, predict, control, and e countermeasure techniques.	(\$ in Millions) terize molecular exploit atomic a	dynamics, rea nd molecular e	ction mechanic energetics for a	cs/interactions, a dvanced fuels, i	and theoretical munitions, and	<u>FY</u> 1	<u>7 2007</u> 3.653	<u>FY 2008</u> 14.423	<u>FY 2009</u> 16.510
	guide their efficient synthesis. Supported a of energy in molecules to improve exhaus high density chemicals for propellants and systems. Enhanced efforts to develop high applications in munitions and propellants.	advance researc at signature dete propulsion system per performance	to understand ction and contri- stems, and to do e, less sensitive	d, predict, and rol capabilities, evelop new hig nano-scale end	control the reac to develop new h-energy chemi ergetic material	tivity and flow v high-energy, ical laser s for				
(U)	In FY 2008: Develop new theoretical and properties of chemicals and materials of in advance understanding of reactivity and e awareness, propellants, munitions, and las plasmonic structures to enhance propulsio	l computational nterest to the Ai nergy flow in m ser systems. Exp on and energetic	methods to en r Force. Contin nolecules for ap plore ability to applications a	hance capabilit nue to develop oplications to si understand and nd sensitive de	ies to predict ar new experimen ignatures, battle l control catalys tection of target	nd simulate tal methods to espace sis and t compounds.				
(U)	In FY 2009: Continue to develop new cap interest to the Air Force. Explore propertie experimental methods to advance understa signatures, battlespace awareness, propell	pabilities to pre- es and potential anding of reacti ants, munitions	dict molecular of nano-scale vity and energ , and laser syst	and macroscop energetic mate y flow in molec ems. Continue	bic properties of rials. Continue cules for applica to develop nove	chemicals of to develop new ations to el applications				
Pro	ject 2303			R-1 Line Iter Page-13	m No. 1 of 49				Exhibit R-2a (F	PE 0601102F)
				13						

	Exhibit R-2a, RDT&E Project Justific	cation	DA	TE February	2008
BUD(01 E	GET ACTIVITY PE Basic Research 06 Se	E NUMBER AND TITLE 601102F Defense Research ciences	PROJECT N 2303 Che	UMBER AND TITLE mistry	
(U)	B. Accomplishments/Planned Program (\$ in Millions) of catalysis and plasmonic structures for applications to propulsion, energetics, and sens for closed-cycle hybrid chemical lasers.	sing. Explore new concepts	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)					
(U)	MAJOR THRUST: Enhance fundamental understanding of polymer chemical structure engineering, processing controls, and materials technologies to develop advanced organ aimed at improving Air Force systems performance and life spans.	es, reactivity, molecular ic and matrix composites	9.488	10.134	12.221
(U)	In FY 2007: Utilized nanotechnology to enhance chemical and physical properties of p photorefractive polymer as a medium for wavefront correction in optical communication flexible structures that can provide functions such as sensing, power generation and stor functionalities for smart skin and multi-functional structures.	olymers. Exploited n and imaging. Explored rage, electronics, and other			
(U)	In FY 2008: Explore power generation and power storage for warfighters based on imp and fuel cells applications. Continue to explore photonic polymers and conductive poly- detections. Investigate 3-D displays based on photorefractive polymers. Polymers with permittivity and magnetic permeability will be explored for advanced radar antenna app mechanisms of carbon single wall nanotubes will be investigated.	proved polymers for solar cells mers for communications and controlled dielectric plications. Control growth			
(U)	In FY 2009: Continue to exploit nanotechnology to enhance functional and mechanical through controlled dispersion, distribution, and placement of the nano-entities for Air F synthesis of new polymers with improved power generation and storage functions will be synthesis, and characterization of conjugated polymers will be conducted to understand mobility of organic based semi-conducting organics and polymers.	properties of polymers orce applications. Control be explored. Modeling, and enhance the charge			
(U)					
(U)	MAJOR THRUST: Expand the fundamental chemistry and physics of surfaces and inter- to corrosion protection, wear reduction, and power storage for air and space systems.	erfacial processes pertaining	6.873	7.414	9.502
(U)	In FY 2007: Explored theoretical and predictive methods for the fundamental understau reactivity of surfaces and how surfaces interact with their environment at the interface. I surface interfaces, including friction and wear, lubrication, corrosion and degradation, s energy storage, and electrochemically induced reaction products and kinetics. Created a multi-functional surface structures, coatings, covers, and lubricants. Investigated novel catalysis and survivability in compact electronic, power, and sensing applications.	nding of the structure and Investigated phenomena at ensing, electrochemical nd characterized novel biophysical mechanisms for			
(U)	In FY 2008: Develop theoretical and predictive methods for the fundamental understan reactivity of surfaces and how surfaces interact with their environment at the interface.	ding of the structure and Continue to investigate			
	R-1 Line Item	n No. 1			
Pro	ect 2303 Page-14 c	of 49		Exhibit R-2a	(PE 0601102F)

	Exhibit R-2a, RDT&E Project Jus	DATE February 2008			
BUD(01 B	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2303 Chei		
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) phenomena at surface interfaces, including friction and wear, lubrication, corrosion approaches to corrosion prevention, particularly multi-disciplinary efforts that comb detection, and lifetime prediction. Continue tribological investigations that focus of between macro and nano scale mechanisms, including heat transfer, chemical reacti Continue to investigate nano-scale surface structures for power applications. In FY 2009: Continue to develop theoretical and predictive methods for the fundam structure and reactivity of surfaces and how surfaces interact with their environmen investigate phenomena at surface interfaces, including friction and wear, lubrication Explore novel approaches to corrosion prevention, particularly multi-disciplinary eff initiation, detection, and lifetime prediction. Continue tribological investigations in provide function over a wide variety of extreme environments, including space.	and degradation. Explore novel bine corrosion initiation, in bridging the fundamental gap wity, and atmospheric effects. mental understanding of the t at the interface. Continue to in, corrosion and degradation. Eforts that combine corrosion in nanocomposite lubricants that	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: New Methods for Designing and Testing Aircraft Coat In FY 2007: Conducted research to explore environmentally friendly and longer-la aging aircraft. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ings. sting anti-corrosion coatings for	1.559	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Smart Surfaces and Interfaces In FY 2007: Conducted research to explore surfaces and interfaces that respond sm In FY 2008: Not Applicable. In FY 2009: Not Applicable.	artly to the surroundings.	0.975	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Fully-Integrated Solar-Powered Interior Lighting Tech In FY 2007: Conducted research to integrate solar-energy-generating photovoltaic r organic materials for self-contained lighting systems for combat locations. In FY 2008: Continue to conduct research to integrate solar-energy-generating phot light-emitting organic materials for self-contained lighting systems for combat locat In FY 2009: Not Applicable.	nology. naterials and light-emitting ovoltaic materials and tions.	0.975	1.591	0.000
(U) (U)	Total Cost		33.523	33.562	38.233
Pro	iect 2303 R-1 Line Page	ltem No. 1 -15 of 49		Exhibit R-2a	(PE 0601102F)

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 01 Basic Research 0601102F Defense Research 2303 Chemistry (U) C. Other Program Funding Summary (\$ in Millions) EY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602200F, Aerospace Propulsion. U) PE 0602200F, Aerospace Estimate Estimate Estimate Estimate U)	Total Cost
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</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</u> <u>Estimate</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> (U) Related Activities: (U) PE 0602102F, Materials. (U) PE 0602203F, Aerospace Propulsion. 	Total Cost
FY 2007FY 2008FY 2009FY 2010FY 2011FY 2012FY 2013Cost toActualEstimateEstimateEstimateEstimateEstimateEstimateEstimateComplete(U)Related Activities:(U)PE 0602102F, Materials.(U)PE 0602203F, Aerospace Propulsion.FY 2012FY 2013Cost to	<u>Total Cost</u>
Actual Estimate Complete (U) PE 0602203F, Aerospace Propulsion. PE 0602500F PE 060	
 (U) PE 0602500F, Multi-Disciplinary Space Technology. (U) PE 0602602F, Conventional Munitions. (U) <u>D. Acquisition Strategy</u> Not Applicable. 	
R-1 Line Item No. 1Project 2303Page-16 of 49Exhibit R-2a (F	PE 0601102F)

	Exh	ibit R-2a, F	DT&E Pro	ject Justifi	ication			DATE	February	2008
BUDGI 01 Ba	ET ACTIVITY asic Research			P 0 S	E NUMBER AND 601102F Defe ciences	TITLE Ense Researd	ch	PROJECT NUME 2304 Mathem Sciences	BER AND TITLE	omputing
	Cost (\$ in Millions)	FY 2007 Actual	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	30.165	24.135	30.586	33.430	36.027	36.373	37.994	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Note:	In FY 2008, Physical Mathematics efforts	in this Project r	noved to Proje	ct 2301 within	this PE to more	e accurately alig	gn basic resear	ch efforts in Ph	ysics.	
N C i t r	Mathematics and computing sciences basic control, and innovative analytical and high mproved performance and control of system echniques and theories. The primary areas nathematics.	research developerformance coms and subsyste of research invo	ops novel techromputing metho mputing methorems through accessing the strength of the strength	niques for math ods for air and ccurate models is project are dy	nematical model space systems. and computatic ynamics and co	ling and simula Basic research onal tools, artifi ntrol, optimiza	tion, algorithm provides fund cial intelligend tion and discre	n development, amental knowle ce, and improve cet mathematics	complex system edge enabling of programming , and computat	ms g ional
(U) (U) (U)	B. Accomplishments/Planned Program (MAJOR THRUST: Perform dynamics and of control systems enhancing capabilities a efforts in basic research on complex network In FY 2007: Improved advance technique uncertain, adversarial environments with a small satellites. Developed control method systems with applications for combustion, processing and sensor technologies for use Investigated methods for design and analy	(\$ in Millions) d control resear and performanc orks require mo s for design and applications to s lologies to impu- materials proce e in UAV contro- sis of bio-inspin	ch to develop i e of advanced netary increase d analysis of co warms of smar rove non-equili essing, and agil ollers, smart mored sensing sys	innovative tech air and space s es in this major poperative contr tr munitions, U ibrium behavior le autonomous unitions, and no stems, controls,	niques for design ystems. Increas thrust. rol systems in c AVs, and const r of complex, u flight. Improve on-destructive	gn and analysis ing level of lynamic, ellations of nsteady fluid d image vehicle testing. onal systems.	<u>FY</u>	<u>7 2007</u> 9.300	<u>FY 2008</u> 11.928	<u>FY 2009</u> 15.650
(U)	In FY 2008: Investigate emerging novel a adversarial environments with applications satellites. Conduct additional research for environments to execute assigned missions modeling to improve non-equilibrium beha materials processing, and agile autonomou for use in UAV controllers, smart munition analysis of bio-inspired sensing systems, c for control of and over dynamic, large-scal verification, and validation of distributed e	ver dynamic, la pproaches for c s to swarms of s teams of micro s with variable avior of comple as flight. Contin ns, and non-des controls, and co le networks. In- embedded syste	rge-scale netw cooperative con- smart munition air vehicles op operator interv ex, unsteady flu- ue to advance tructive vehicle mputational sy- vestigate theory ms. Research p	orks. htrol systems in as, UAVs, and co perating at vario rention. Advance uid systems wit image processi e testing. Adva stems. Continu y and algorithm potential device	a dynamic, unce constellations o bus altitudes in ce control methe th applications f ing and sensor t unce methods fo the development as for specificat es to exploit nor	ertain, f small complex odologies and for combustion, echnologies or design and of algorithms ion, design, nlinear	,			
Proje	ct 2304			R-1 Line Iter Page-17 (17	m No. 1 of 49				Exhibit R-2a (PE 0601102F)

	Exhibit R-2a, RDT&E Project Justification	Ľ	DATE February 2008		
BUD(01 B	GET ACTIVITY PE NUMBER AND TITLE Basic Research 0601102F Defense I Sciences	Research 2304 Mat Sciences	NUMBER AND TITLE Inematics and C	omputing	
(U)	B. Accomplishments/Planned Program (\$ in Millions) dynamic phenomena with a focus on detection, classification, and control systems for use in urban combat	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Further develop the design and analysis techniques for cooperative control systems in dynamic uncertain, adversarial environments with applications to swarms of smart munitions, UAVs, and constellatio small satellites. Continue additional research for teams of micro air vehicles operating at various altitudes in environments to execute assigned missions with variable operator intervention. Continue developing control methodologies to improve non-equilibrium behavior of complex, unsteady fluid systems. Continue to advance processing and sensor technologies for use in UAV controllers, smart munitions, and non-destructive vehicle Develop methods for design and analysis of bio-inspired sensing systems, controls, and computational system Continue development of algorithms for control of and over dynamic, large-scale networks. Develop theory algorithms for specification, design, verification, and validation of distributed embedded systems. Design no devices to exploit nonlinear dynamic phenomena with a focus on detection, classification, and control system use in urban combat environments	complex complex ce image e testing. ms. and ovel ms for			
(U) (U)	MAJOR THRUST: Research physical mathematics, applied analysis, and electromagnetics. Note: In FY 20 efforts previously in this Major Thrust were moved into Project 2301 in this PE to more accurately align bas	008, 9.787 .ic	0.000	0.000	
(U)	In FY 2007: Developed enhanced models of physical phenomena to advance the fidelity of simulations. Inv properties of coherently propagating ultra-short laser pulses through the atmosphere. Developed algorithms t simulate nonlinear optical effects within fiber lasers and nonlinear optical media. Investigated the dynamics transonic/supersonic/hypersonic platforms. Studied the design of reconfigurable warheads through suitable placement of micro-detonators. Improved methods for recognizing and tracking targets and for penetrating c or other dispersive media that obscure targets	restigated to of coverings			
(U) (U)	In FY 2009: Not Applicable. In FY 2009: Not Applicable.				
(U)	MAJOR THRUST: Conduct research in optimization, as well as computational and discrete mathematics to and further advance mathematical methods, algorithms, and modeling and simulation to solve problems and designs of advanced Air Force systems.	validate 11.078 improve	11.213	14.936	
(U)	In FY 2007: Elucidated complex problems in system diagnostics/prognostics, air mobility contingencies, tar tracking, and strategic/tactical planning for battlespace information management. Developed innovative met	rget hods and			
Pro	R-1 Line Item No. 1 ject 2304 Page-18 of 49 18		Exhibit R-2a	(PE 0601102F)	

	Exhibit R-2a, RDT&E Project Jus	tification	DA	February	/ 2008
BUD(01 E	GET ACTIVITY asic Research	PROJECT N 2304 Mati Sciences	omputing		
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) algorithms that will improve modeling and simulation capabilities. Integrated new rooptimization strategies with high-order, time-accurate solutions for superior design devices, munitions and penetrators, air and space components, and system health at Developed mathematical method for solving large or complex problems in logistics target tracking, and strategic/tactical planning for battlespace information managem analysis in non-linear models of aerodynamic flows and structural failure prediction In FY 2008: Continue to develop mathematical methods for solving large and com diagnostics/prognostics, air mobility contingencies, target tracking, and strategic/ta	multi-disciplinary design of jet engines, directed energy ad maintenance systems. s, air mobility contingencies, nent. Enhanced uncertainty ns. plex problems in logistics, system ctical planning for battlespace	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	information management. Approaches will include both rigorous analytical tools ar Continue to develop innovative mathematical and numerical algorithms that will in capabilities in order to increase understanding, prediction, and design of large and of the Air Force. These phenomena include aerodynamics for various flight regimes, h design, and structural mechanics. Continue to develop and integrate new multi-disc strategies with high-order, time-accurate solutions for superior design of jet enginese munitions and penetrators, micro air vehicles, air and space components, and system systems. Enhance uncertainty quantification based on rigorous error analysis in nor flows and structural failure predictions. Develop mathematical models that are dyna with operational data that are possibly incomplete, uncertain, conflicting, or overlap	ad meta heuristic searches. nprove modeling and simulation complex phenomena of interest to high power microwaves, material iplinary design optimization s, directed energy devices, n health and maintenance h-linear models of aerodynamic amically evolving that would deal oping.			
(U)	In FY 2009: Develop rigorous mathematical methods for solving large and complet diagnostics/prognostics, air mobility contingencies, target tracking, and strategic/tar information management. Enhance the analytical tool developments in operation re and robust and stochastic optimization. Focus on developing innovative and accura algorithms that will improve modeling and simulation capabilities. These phenome applicable to a range of flight regimes such as hypersonics and micro air vehicles. On new multi-disciplinary design optimization strategies with high-order, time-accurat jet engines, directed energy devices, munitions and penetrators, air and space comp maintenance systems. Continue to enhance uncertainty analysis in non-linear mode structural failure predictions. Continue to develop mathematical models that are dyn deal with operational data that are possibly incomplete, uncertain, conflicting, or ow	ex problems in logistics, system ctical planning for battlespace search, meta heuristic searches, te mathematical and numerical na include aerodynamics as Continue to develop and integrate e solutions for superior design of onents, and system health and ls of aerodynamic flows and namically evolving that would verlapping.			
(U) (U)	CONGRESSIONAL ADD: Process Integrated Mechanism for Human-Computer C	collaboration and Coordination	0.000	0.994	0.000
Pro	ect 2304 R-1 Line Page	e Item No. 1 -19 of 49 19		Exhibit R-2a	(PE 0601102F)

BUDGET ACTIVITY PEROMETER ACTIVITY PROJECT NUMBER AND TITLE Sciences PROJECT NUMBER AND TITLE Sciences (U) B. Accomplishments/Planned Program (\$ in Millions) EY 2007 EY 2008 EY 2008 EY 2008 EY 2008 EY 2007 EY 2008 EY 2008 EY 2007 EY 2008 EY 2009 EY 2010 EY 2011 EY 2012 EY 2013 Coast to Coast to Coast to Extended Activities: Extended Estimate Estimate Estimate Estimate Estimate Estimate Estimate Estimate Coast to Complete Total Co (U) PE 0602200F, Acrospace Flight Dynamics. Eye 060276F, Command, Courcol, and Communications. Eye 1000 Eye 0602702F, Command, Courcol, and Command, Courcol, and Command, Courcol, and Command, Commond, Eye 1000 Eye 100 Eye 100 Eye 100 Eye 100 Eye 100 Eye		Exhibit R-2a, RDT&E Project Justification February 2008										
 B. Accomplishments/Planned Program (\$ in Millions) FY 2007 FY 2008 FY 200 In FY 2007 EX Applicable. In FY 2008: Develop a novel technology of a process integrated mechanism, which ties together computers and humans into a single collaborating system by virtue of a single program that rapidly moves between all the computers in the system. In FY 2008: Nov Applicable. In FY 2009: Not Applicable. Total Cost C. Other Program Funding Summary (\$ in Millions) FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 EY 2013 Cost to Total Cost C. Other Program Funding Summary (\$ in Millions) FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 EY 2013 Cost to Total Cost U. Related Activities: (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602500F, Manuel Complete Technology. (D) PE 0602500F, Conventional Munitions. (U) PE 0602702F, Conventional Munitions. (U) D. Acquisition Strategy Not Applicable. 	BUD [.] 01 E	GET ACTIVITY Basic Research		PE NUMBER AND TITLEPRO0601102F Defense Research230SciencesSciences			PROJECT NUM 2304 Mather Sciences	OJECT NUMBER AND TITLE 04 Mathematics and Computing iences				
 (U) <u>FC 00ther Program Funding Summary (\$ in Millions)</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2019</u> <u>FY 2011</u> <u>FY 2012</u> <u>FY 2013</u> <u>Cost to</u> <u>Total Co</u> <u>Actual Estimate Estimate Estimate Estimate Estimate Complete</u> <u>Total Co</u> (U) Re 10602201F, Aerospace Flight Dynamics. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602500F, Multi-Disciplinary Space Technology. (U) PE 0602702F, Conventional Munitons. (U) PE 0602702F, Command, Control, and Communications. (U) PE 0602702F, C31 Advanced Development. (U) D. Acquisition Strategy Not Applicable. 	(U) (U) (U) (U)	B. Accomplishments/Planned P In FY 2007: Not Applicable. In FY 2008: Develop a novel tech humans into a single collaborating in the system. In FY 2009: Not Applicable. Total Cost	rogram (\$ in Mil nology of a proce g system by virtue	lions) ss integrated m of a single pro	echanism, which gram that rapidly	n ties together co y moves betweer	omputers and n all the compute	Ers	<u>Y 2007</u> 30.165	<u>FY 2008</u> 24.135	<u>FY 2009</u> 30.586	
FY 2007 FY 2008 FY 2010 FY 2011 FY 2012 FY 2013 Cost to (U) Related Activities: Actual Estimate Complete Total Co (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602500F, Multi-Disciplinary Space Technology. (U) PE 0602602F, Conventional Munitions. (U) PE 0602702F, Command, Communications. (U) PE 0603789F, C3I Advanced Development. (U) PE 0603789F, C3I Advanced Development. (U) D. Acquisition Strategy Not Applicable.	(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u>	ons)								
R-1 Line Item No. 1	(U) (U) (U) (U) (U) (U) (U)	Related Activities: PE 0602201F, Aerospace Flight Dynamics. 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. D. Acquisition Strategy Not Applicable.	<u>FY 2007</u> <u>Actual</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>	FY 2012 Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>	
Project 2304 Page-20 of 49 Exhibit R-2a (PE 0601102) 20	Pro	ject 2304			R-1 Lin Page	e Item No. 1 -20 of 49				Exhibit R-2a	(PE 0601102F)	

	Ext	nibit R-2a, F	DT&E Pro	ject Justif	ication			DATE	February	2008
BUDGE 01 Ba	ET ACTIVITY Isic Research			P 0 5	PE NUMBER AND 0601102F Defe Sciences	TITLE ense Researd	:h	PROJECT NUME 2305 Electro	BER AND TITLE	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ III Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2305	Electronics	34.245	32.963	39.289	40.943	43.636	43.689	43.502	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
E d c a e b s	Electronics basic research generates and ex levice implementation schemes vital to ad- control, electronic countermeasures, stealth dvances processing and fabrication science electronic, sensor, and optoelectronic struct oreakthroughs essential for future leaps in ystem power, size, mass, and life cycle co	ploits fundament vance Air Force in technologies, a es, and develop tures and device warfighter syste sts.	ntal knowledge operational ca and directed en s and impleme concept imple m performance	and understan pabilities in su ergy weapons. nts advanced p ementation sch e, functionality	nding of novel s rveillance, info Solid - state el physical modelin remes. Research r, reliability, and	olid - state elec rmation and sig ectronics resea ng and simulati n stresses high- l survivability,	tronic, sensor, gnal processing rch discovers on capabilities risk, far-term, while simultar	, and optoelectro g, communication and develops not s essential to evang game-changing neously reducin	onic materials a ons, command a ew materials, aluate novel g capability g component ar	nd and ad
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Investigate novel deta implementation schemes important to futu and functionality, while simultaneously re- high-risk, innovative, and potential-breakt high-sensitivity multi-spectral detection, h data storage, and advanced high-power, bu In FY 2007: Investigated novel materials	(\$ in Millions) ector and electro ire military space educing component through materia high-speed and l road-band, high for reconfigura	onic materials, e platforms for ent power, size ls, devices, and nigh-throughpu ly efficient X-V ble electronics	device concep r increased sys e, and mass. Re l circuit concep it data processi W band radar a produced fron	ots, and circuit as stem reliability, esearch is focus pts enabling futu ing, high-density and communicat n major review of	rchitecture and survivability, ed on ure generation y non-volatile tions. of entire	<u>F</u>)	<u>7.546</u>	<u>FY 2008</u> 7.785	<u>FY 2009</u> 9.366
(U)	program. Researched efforts on wide band Defense Advanced Research Projects Age DoD and commercial space interests, and In FY 2008: Investigate novel reconfigure dynamically tailoring their physical prope magnetic fields, optical signals, heat, mec tuning their physical properties in respons or system requirements, such as that drive requirements. Investigate innovative mult utilizing breakthroughs in material electron phenomenology-based detection mechanis interfacing and interconnect schemes, and	Igap gallium nit ency (DARPA) more aggressiv able multi-funct rties via applica hanical stress, c e to dynamicall on by natural or i-spectral and m onic bandgap an sms, novel mate biologically-ba	ride materials program. Linke ely sought spac ional electroni tion of one or hemical proces y changing ele radiation induc ulti-phenomen d defect-band t rial and device sed detection p	and devices an ed university n ce launches for c materials tha more 'stimuli', sses, etc., with ctronic and/or ed degradatior ology-based d uning concepts functionality, processes. R-1 Line Ite	and transitioned to anosatellite pro- the best nanosa the best nanosa such as electric the end objective optoelectronic of n and/or changin etector concepts s, absorption novel hetero-m	o major jects to key atellite projects l for and/or ve of precisely device, circuit, ng mission s/approaches aterial			Evhibit P.2a (25.06011025)
Proje	ct 2305			Page-21	of 49				Exhibit R-2a (F	PE 0601102F)

	Exhibit R-2a, RDT&E Pro	ject Justification	D.	February	/ 2008
BUD(01 B	GET ACTIVITY Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2305 Elec	IUMBER AND TITLE Stronics	
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Continue investigating novel innovative reconfigurable mu bandgap and defect-band tuning concepts, phenomenology-based detect interfacing and interconnect schemes, and novel nanoscience and biolog 'smart' reconfigurable materials whose properties can be dynamically tai software in response to changing behavior or mission needs. Focus on no tailoring novel hybrid material systems such as metamorphic and heterog	lti-functional electronic materials, material ion mechanisms, novel hetero-material ically-based detection processes. Investigate lored via self-programming or system ovel 'programmable pathways' to enable geneous systems.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	MAJOR THRUST: Investigate quantum and optoelectronic materials ar processing, as well as nano-science for wide-field spectral sensors and co order to achieve communications and spectral dominance of the battlesp and target signature identification.	nd devices, memory, and information ritical, high-speed communication systems in ace to include surveillance, target tracking,	14.450	14.245	15.827
(U)	In FY 2007: Investigated nonlinear optical and laser materials, devices, protection, cloaking and tracking, and target signature identification. Exp other advanced optoelectronic and electronic materials and devices for lo lasers wavelength-diverse, high sensitivity detectors. Examined advance data storage. Investigated technologies for robust monolithic and miniatu quantum cascade lasers. Investigated communication network technolog materials, and the interaction of system electronics and sensors with atm	and fabrication processes for radiation plored nanoelectronics, nanophotonics, and ower power consumption, high-efficiency d optical memory technologies for enhanced are terahertz frequency spectrum devices and ies, room temperature ferromagnetic ospheric and space environments.			
(U)	In FY 2008: Continue to investigate nonlinear optical and laser material radiation protection, cloaking and tracking, and target signature identific nanophotonics, spintronics and other advanced optoelectronic and electro consumption, high-efficiency wavelength-diverse lasers, high sensitivity advanced optical memory technologies for enhanced data storage, include metastructures. Investigate technologies for robust monolithic and minia and quantum cascade lasers. Continue to investigate communication network ferromagnetic materials, and the interaction of system electronics and se environments.	Is, devices, and fabrication processes for eation. Continue to explore nanoelectronics, onic materials and devices for lower power detectors. Further the examination of ling negative index of refraction ture terahertz frequency spectrum devices work technologies, room temperature nsors with atmospheric and space			
(U)	In FY 2009: Further investigate nonlinear optical and laser materials, de radiation protection, cloaking and tracking, and target signature identific nanophotonics, spintronics, multi-functional materials, and other advanc materials and devices for lower power consumption, high-efficiency way	evices, and fabrication processes for eation. Continue to explore nanoelectronics, ed optoelectronic, magnetic, and electronic velength-diverse lasers, high sensitivity			
Proj	ject 2305	R-1 Line Item No. 1 Page-22 of 49		Exhibit R-2a	(PE 0601102F)

	Exhibit R-2a, RDT&E Project Justi	fication	D/	February	/ 2008
BUD(01 B	GET ACTIVITY asic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2305 Elec	UMBER AND TITLE	
(U)	B. Accomplishments/Planned Program (\$ in Millions) detectors. Further the examination of advanced optical memory technologies for enhance negative index of refraction metastructures and photonic crystals. Investigate technologies miniature terahertz frequency spectrum devices and quantum cascade lasers, as well a investigate communication network technologies, room temperature ferromagnetic m system electronics and sensors with atmospheric and space environments.	nced data storage, including ogies for robust monolithic and as plasmonics. Continue to aterials, and the interaction of	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	MAJOR THRUST: Exploit advances in nanotechnology to support multi-spectral det chip-scale optical networks. In FY 2007: Developed techniques to control growth of self-assembled quantum stru	tection technology and ctures and connections to these	5.091	5.258	6.839
	structures for multi-spectral image processing. Developed nanoelectronics and nanople free space optoelectronic device technology and methods for their integration to enable that will overcome future interconnect problems. Explored nanophotonic concepts for components and systems.	hotonics for guided wave and le chip-scale optical networks r information processing			
(U)	In FY 2008: Further develop and refine techniques to control growth of self-assemble connections to these structures for multi-spectral image processing. Test functionalitie improve growth methods. Continue developing nanoelectronics and nanophotonics fo optoelectronic device technology and methods for their integration to enable chip-sca overcome future interconnect problems. Continue exploring nanophotonic concepts for components and systems.	ed quantum structures and es of structural materials and or guided wave and free space le optical networks that will or information processing			
(U)	In FY 2009: Exploit controlled growth of self-assembled quantum structures and con multi-spectral image processing. Continue testing functionalities of structural material methods. Continue developing and improving knowledge of nanoelectronics and nance free space optoelectronic device technology and methods for their integration to enable that will overcome future interconnect problems. Continue exploring nanophotonic co- processing components and systems.	nections to these structures for ls and improve growth ophotonics for guided wave and le chip-scale optical networks oncepts for information			
(U) (U)	MAJOR THRUST: Investigate quantum electronic solids phenomena to explore super negative index, and nanoscopic materials to produce superconducting tapes for compa magnets, and for advanced sensors, communications, lightweight antennas, signal pro- memory	erconducting, magnetic, act power generators and pcessing, and ultra-dense	5.500	5.675	7.257
(U)	In FY 2007: Exploited methodologies to fabricate new high current, high-temperature	e superconducting materials for			
Pro	ect 2305 R-1 Line It Page-2:	em No. 1 3 of 49		Exhibit R-2a	(PE 0601102F)

	Exhibit R-2a, RDT&E Proje	ect Justification	D/	February	/ 2008	
BUD(01 B	GET ACTIVITY asic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2305 Elec	ECT NUMBER AND TITLE Electronics		
(U)	B. Accomplishments/Planned Program (\$ in Millions) enhanced power generation and storage devices. Searched for high-temperative magnetic materials for power devices, switches, and bear Searched for 3-D negative index materials in the infrared and visible region circuit elements with smaller size and increased functionality.	ature superconductors. Developed rings in aircraft electrical systems. ns, and used those materials to make	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Recent success in increasing current-carrying properties of hi sections of tape will be exploited to increase those properties in longer leng eddy-current loses. Microwave properties of high-temperature superconduct of recent progress in reducing losses at high frequencies. The goal is to pro- that can provide improved radar systems and compact communications sys- higher-temperature superconductors will continue. Efforts to create true 3- from microwave to infrared and visible will be augmented. The search for magnetic materials will continue using innovative nanomaterial technology nanomaterials, new compact architectures will be created to further miniate memory storage, and sensing.	gh-temperature superconducting short gths and attempts will be made to reduce ctors will receive added emphasis because ovide thin-film superconducting material stems. The search for practical even D negative index material at frequencies higher-temperature, high-energy-product y. Using carbon nanotubes and other urize devices for signal processing,				
(U)	In FY 2009: Using improved planar thin-film Josephson-junction technolo amplifier will be constructed and tested. Attempts to fabricate high-temper materials will be given greater emphasis in providing support for the More systems. Studies to reduce eddy-current losses and to prevent quenching in as the tape technology reaches desired goals. Progress in seeking practical range of frequencies will continue. Nanoelectronic circuitry based on nano receive added emphasis in attempting to promote miniaturization, greater f for new higher-temperature (and practical) superconductors will continue.	bgy, a low-noise, wide-bandwidth rature, high-performance magnetic Electric Airplane and other advanced a superconducting tapes will be augmented negative index materials over a broad omaterials and new concepts also will functionality, and lower losses. Searches				
(U) (U) (U) (U)	CONGRESSIONAL ADD: Nanophotonic Components. In FY 2007: Conducted basic research in nano-materials and nano-manufa In FY 2008: Not Applicable. In FY 2009: Not Applicable.	acturing for military photonic applications.	1.658	0.000	0.000	
(U)	Total Cost		34.245	32.963	39.289	
Pro	ect 2305	R-1 Line Item No. 1 Page-24 of 49 24		Exhibit R-2a	(PE 0601102F)	

	Exhibit R-	2a, RDT&E	Project Ju	stification				DATE February 2008		
BUDGET ACTIVITY 01 Basic Research				PE NUMBER A 0601102F D Sciences	ND TITLE efense Resea	rch	PROJECT 2305 El	NUMBER AND TITLE		
(U) <u>C. Other Program Funding Su</u>	<u>nmary (\$ in Milli</u>	<u>ons)</u>								
	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	<u>FY 2</u> <u>Estir</u>	013 Cost to nate Complete Total Cost		
 (1) Pi: 060/204F, Aerospace Sensors. (U) PE 0602702F, Command, Control, and Communications. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603789F, C31 Advanced Development. (U) D. Acquisition Strategy Not Applicable. 										
Project 2305			R-1 Lin Pag	e Item No. 1 e-25 of 49				Exhibit R-2a (PE 0601102F)		
			UNCI	25 ASSIFIED						

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDGI 01 Ba	ET ACTIVITY Isic Research			P 0 5	PE NUMBER AND 1601102F Defe Sciences	TITLE ense Researd	:h	PROJECT NUME 2306 Materia	BER AND TITLE	
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total
2306	Materials	39.054	37.436	25.681	25.118	26.659	27.335	5 27.633	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U) <u>2</u> M t r i r r	A. MISSION Description and Budget Item Materials basic research enhances the perfo oughness, fatigue, and environmental cond naterials for airframe, turbine engine, and ncreased structural efficiency and reliabili esearch focus is on refractory alloys, inter- nethods. The primary areas investigated b	Distinction ormance, cost, a ditions. This res spacecraft struc ty, increase the metallics, polyn by this project a	nd reliability o earch expands tures. The goal operating temp her composites re ceramics, no	f structural ma fundamental k ls of this projec perature of engi , metal and cer on-metallic hyb	terials to elimin nowledge of ma ct are to develop ine materials, ar amic matrix con orid composites.	ate reliability i aterial propertie o improved mat ad further incre mposites, advan , and metallic n	ssues related tes that leads to erials for air a ase thrust-to- nced ceramics naterials.	to high-temperate to the development and space vehicl weight ratio of e s, and new mater	ture strength, nt of novel es that provide ngines. A prima ial processing	ary
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Perform non-metallic materials and composites with very-high (inorganic matrix composites, functional n increase the strength, application, and life	(\$ in Millions) c, ceramic, and l (>1400F) and ul naterials (includ e span of air and	nybrid material tra-high (>250 ing adhesives/e space structura	s research to ic 0F) temperatur epoxies), and h al materials.	dentify and to de re applications. tybrid carbon m	esign new Create aterials to	<u>F</u> Y	<u>Y 2007</u> 9.266	<u>FY 2008</u> 9.481	<u>FY 2009</u> 12.351
(U)	In FY 2007: Optimized the thermal and m applications. Exploited new approaches to structurally enhanced smart systems for a and joining methodologies for lightweight temperature and more damage-tolerant or and nanocomposites that will enable reduce multi-functional performance of load-beau	nechanical stabi o designing mult pplication in ext t ceramic mater ganic, inorganic ced system weig ring aerospace s	ity of oxide ce i-functional str reme environn als. Examined , and polymer ght and/or size, tructures.	eramic compos ructural cerami nents. Investiga innovative cor matrix compos increased oper	ites for aircraft ics materials to ated high-tempe ncepts for devel sites. Developed rational lifetime	and engine enable erature resistant oping higher l nanomaterials e, and				
(U)	In FY 2008: Continue to optimize the desenhanced smart systems for application in and mechanical stability of oxide ceramic high-temperature resistant and joining me innovative concepts for developing higher matrix composites. Continue to develop the nanocomposites in aerospace structures.	sign of multi-fun n extreme enviro composites for ethodologies for r temperature an he fundamental	nctional structu nments. Explo aircraft and en lightweight ce d more damag knowledge bas	ral ceramics m it new approac gine applicatio ramic materials e-tolerant orga se to exploit the	naterials to enab thes in improvir ons. Further dev s. Continue to d nic, inorganic, a e use of nanoma	le structurally ng the thermal elop evelop and polymer atterials and				
(U)	In FY 2009: Continue optimizing the des enhanced smart systems for application in	ign of multi-fun n extreme enviro	ctional structu nments. Expar	ral ceramics m nd the developr	aterials to enabl ment of new app	le structurally proaches in				
Proje	ct 2306			R-1 Line Iter Page-26	m No. 1 of 49				Exhibit R-2a (F	PE 0601102F)
				26						

	Exhibit R-2a, RDT&E Project	Justification	D	February	/ 2008
BUDG 01 B	BET ACTIVITY asic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2306 Mate	UMBER AND TITLE erials	
(U)	B. Accomplishments/Planned Program (\$ in Millions) improving the thermal and mechanical stability of oxide ceramic composites fo Continue to further develop high-temperature resistant and joining methodologi Expand the development of innovative concepts for developing higher temperator organic, inorganic, and polymer matrix composites. Continue to expand the development of nanomaterials and nanocomposites in aero	r aircraft and engine applications. ies for lightweight ceramic materials. ture and more damage-tolerant velopment of the fundamental ospace structures.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Research metallic materials and identify relationships betw microstructures), processing, properties, and performance so as to develop affor	veen structures (including rdable and durable metallic systems	10.288	10.460	13.330
(U)	In FY 2007: Investigated lightweight structural materials, refractory metals, in and their composites, and micro-laminated materials for sustainable use in aero verified physics-based, quantitative, predictive models that relate processing, cl and performance of metallic materials.	termetallic alloys, amorphous alloys space applications. Developed and hemistry, and structure with properties			
(U)	In FY 2008: Continue investigating metallic materials for sustainable use in str engines. Investigate nano-laminates and nano-composites for aerospace armor a Explore the interaction between chemistry and mechanics in surfaces and interf Explore the processing and development of multifunctional structural metals fo applications. Capitalize on advances in multi-scale modeling to study the respon corrosive environments and cyclical loading. Develop an informatics process est materials' properties data derived from modeling and experimentation. Explore and thermal effects during friction stir processing	ructural applications and advanced and small air vehicle structures. Faces of these nanoscale structures. or power systems and space nse of aerospace alloys exposed to xploiting disparate sources of the fundamental science of friction			
(U)	In FY 2009: Further investigate nano-laminates and nano-composites for aeros structures. Explore the interaction between chemistry and mechanics in the surf structures. Further explore the processing and development of multifunctional s and space applications. Further develop and verify multi-scale models to study exposed to corrosive environments and cyclical loading. Continue development disparate sources of materials' properties data derived from modeling and exper fundamental science of friction and thermal effects during friction stir processing environmentally sustainable methods to process aerospace alloys.	space armor and small air vehicle faces and interfaces of these nanoscale structural metals for power systems the response of aerospace alloys t of an informatics process to exploit rimentation. Continue research on the ng. Investigate affordable and			
(U) (U)	CONGRESSIONAL ADD: National Aerospace Leadership Initiative.		19.500	15.904	0.000
Proj	R-1 ect 2306	Line Item No. 1 Page-27 of 49 27		Exhibit R-2a	(PE 0601102F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUD(01 E	GET ACTIVITY Basic Research				PE NUMBER AND TITLEPROJEC0601102F Defense Research2306 ISciences2306 I				ECT NUMBER AND TITLE Materials		
(U) (U) (U)	B. Accomplishments/Planned Pro In FY 2007: Supported aerospace R equipment manufacturers' R&D. In FY 2008: Continue to support aer aerospace equipment manufacturers	gram (\$ in Mil &D, fortified U rospace R&D, f ' R&D.	lions) U.Sbased manu Fortif U.Sbased	facturing supply	chain, and strer supply chain, an	ngthen aerospace	, ,	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Hybrid In FY 2007: Not Applicable. In FY 2008: Conduct research to de longer service life.	Materials for T evelop advance	hermal Manage d aeronautical st	ment in Thin Fil ructural membe	ms and Bulk Co rs, sheathing, an	omposites. Id coatings havin	g	0.000	1.591	0.000	
(U) (U)	Total Cost							39.054	37.436	25.681	
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602102F, Materials. PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0602500F, Multi-Disciplinary Space Technology. PE 0602601F, Space Technology. PE 0603211F, Aerospace Structures. PE 0708011F, Industrial Preparedness.	ary (\$ in Millio <u>FY 2007</u> <u>Actual</u>	ons) FY 2008 Estimate	<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>	<u>Total Cost</u>	
Pro	ject 2306			R-1 Line Page	e Item No. 1 -28 of 49				Exhibit R-2a	(PE 0601102F)	

Exhibit R-	DATE February 2008	
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2306 Materials
(U) D. Acquisition Strategy Not Applicable.		
Project 2306	R-1 Line Item No. 1 Page-29 of 49	Exhibit R-2a (PE 0601102F)
	29 LINCI ASSIEIED	

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008	
BUDG 01 B a	DGET ACTIVITY Basic Research				PE NUMBER AND TITLE PRO. 0601102F Defense Research 230 Sciences				ROJECT NUMBER AND TITLE 307 Fluid Mechanics		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
2307	Fluid Mechanics	13.576	14.366	18.486	20.812	22.467	23.080	23.199	Continuing	TBD	
	Quantity of RDT&E Articles		0	0	0	0	0	0			
	and space vehicles. The goals are to improve methods used to expand current flight performance Basic research emphasis is on turbulence p primary approach is to perform fundamenta flows, prediction of real gas effects in high investigated by this project are unsteady are turbomachinery flows.	ve theoretical m ormance bounda rediction and co al experimental -speed flight, an prodynamics, su	odels for aeroc aries through er ontrol, unsteady investigations ad control and personic and h	lynamic predict nhanced unders y and separated and to formula prediction of tu ypersonic aeroo	tion and design standing of key l flows, subsoni te advanced con urbulence in flig dynamics, turbu	, as well as to o fluid flow (prin c/supersonic/hy mputational me ght vehicles and ilence, and rota	priginate flow marily high-sp ypersonic flow thods for the solution solution propulsion solution ting and intern	control concep peed air) pheno vs, and internal simulation and ystems. Primar nal flows chara	ts and predictive mena. fluid dynamics. study of comple y areas of resear cteristic of	The ex ch	
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Investigate and chara and turbulent flows to enable and optimiz In FY 2007: Characterized and modeled of vortex-dominated flows and to develop ra higher-fidelity models for unsteady aerody shock-dominated flows (engine inlets), an	(\$ in Millions) acterize complex e the design of a critical phenom- pid maneuver c ynamics of com ad nonequilibriu	a phenomena in air and space v ena required to ontrols on UA' plex, hyperson m effects. Dev	n supersonic, hy ehicles and flig predict and co Vs. Validated c ic flows to incl eloped control	ypersonic, bour ght control syste introl unsteady, current models a lude boundary l strategy model	ndary layers, ems. and explored layer effects, s for mitigating rated flows	<u>F</u> <u></u>	<u>¥ 2007</u> 5.285	<u>FY 2008</u> 5.492	<u>FY 2009</u> 8.744	
(U) (U)	In FY 2008: Characterize and unsteadness in prediction and control of laminar-turbulen Extend applicability and capability to han shock-dominated flows, and nonequilibriu excessive heat transfer and unsteadiness in In FY 2009: Extend efforts to characteriz laminar-turbulent transition to include inte unsteady numerical simulation methodolo strategies for control of excessive heat tra- local loads on systems. Explore interaction high-temperature vehicle materials with th	a hypersonic fic damental pheno- nt transition and dle complex flo um effects. Com n hypersonic flo er and model fur eractions betwee- ogies for shock- onsfer, unsteadin ns between seve- he goal of reduc	we and for abar mena of 3-D hi the onset of se ws of high-fide inue developm ws and for abar adamental pheren multiple ins dominated flow ess, and separate phenomena ing thermal pro-	sigh-speed boun evere heating ra- elity, unsteady a ent of control s ating the effects nomena of high tability modes. vs and nonequil ation in hyperso in aerothermoo otection system	dary layers to f ates in high-spe- numerical mod strategy models s of highly sepa n-speed boundar Validate high- librium effects. onic flows to re dynamic environ n complexity an	Facel flows. Facilitate ed systems. els for s for mitigating rated flows. ry fidelity, Extend duce severe onment and d increasing					
Proje	ect 2307		-	R-1 Line Iter Page-30	m No. 1 of 49	-			Exhibit R-2a (I	PE 0601102F)	
	Exhibit R-2a, RDT&E Project Justifica	DA	TE February	/ 2008							
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BUD(01 B	GET ACTIVITY PE N asic Research 060' Scie	UMBER AND TITLE 102F Defense Research Inces	PROJECT N 2307 Fluic	UMBER AND TITLE I Mechanics							
(U)	B. Accomplishments/Planned Program (\$ in Millions) performance to improve reusability, sustainability, efficiency, and turn time of hypersonic	and space-access vehicles.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>						
(U) (U)	MAJOR THRUST: Expand fundamental knowledge of unsteady flows in integrated theor computational efforts. Study complex rotating and internal flow phenomena related to turb applications with an emphasis on flow control approaches	etical, experimental, and omachinery and jet engine	6.342	6.489	9.742						
(U)	In FY 2007: Evaluated advanced flow control coupling mechanisms in complex, turbulen phenomena and time accurate simulation techniques. Evaluated reduced order, closed-loop on unsteady flow of complex geometries and jet engines. Developed large eddy simulation transfer and fluid flow coupling in preliminary simulations of film cooling flows. Evaluate techniques for accurately modeling turbulent flows. Evaluated coupling between aerodyna mistuning mechanisms in multiple blade row interactions tied to high cycle fatigue failures tools for unsteady flow control approaches using sensors and actuators for harsh environm	t flows, including transient o flow control mechanisms a techniques to include heat d hybrid computational mic and structural s. Developed predictive ents.									
(U)	In FY 2008: Further develop reduced order, closed-loop flow control mechanisms on unst geometries and jet engines. Investigate new applications of flow control techniques to imp and efficiency for a wider range of flight operating conditions. Develop tools for predictin vortex-dominated flows on unmanned aerial vehicles (UAVs). Explore and develop innov improving convective heat transfer at all flow scales to enhance thermal management of su flight systems.	eady flows of complex rove jet engine integration g and controlling unsteady, ative techniques for ibsonic and supersonic									
(U)	In FY 2009: Continue to develop reduced order, closed-loop flow control mechanisms on complex geometries and jet engines and identify specific applications to transition technol model promising applications of flow control techniques to improve jet engine integration range of flight operating conditions. Validate tools for predicting and controlling unsteady on UAVs. Continue to develop innovative techniques for improving convective heat trans enhance thermal management of subsonic and supersonic flight systems.	unsteady flows of ogy. Characterize and and efficiency for a wider v, vortex-dominated flows fer at all flow scales to									
(U) (U)	CONGRESSIONAL ADD: Development and Validation of Advanced Design Technologi (National Hypersonic Research Center)	es for Hypersonic Research	1.949	2.385	0.000						
(U) (U)	In FY 2007: Conducted research on experimental and numerical simulation to characteriz numerical methods for physical phenomena associated with hypersonics. In FY 2008: Continue research on experimental and numerical simulation to characterize numerical methods for physical phenomena associated with hypersonics.	e and develop predictive and develop predictive									
Proj	ect 2307 R-1 Line Item N Page-31 of 4	o. 1 9		Exhibit R-2a	(PE 0601102F)						

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD 01 E	GET ACTIVITY Basic Research				PE NUMBER A 0601102F D Sciences	ND TITLE efense Resea	rch	PROJECT NUM 2307 Fluid M	IBER AND TITLE Iechanics	
(U) (U)	B. Accomplishments/Planned Pr In FY 2009: Not Applicable.	ogram (\$ in Mil	<u>lions)</u>				E	Y 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	Total Cost							13.576	14.366	18.486
	C. Other Program Funding Summa Related Activities: PE 0602102F, Materials. PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0603211F, Aerospace Structures. D. Acquisition Strategy Not Applicable.	<u>mary (\$ in Milli</u> <u>FY 2007</u> <u>Actual</u>	ons) FY 2008 Estimate	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Pro	ject 2307			R-1 Lin Page	e Item No. 1 9-32 of 49 32				Exhibit R-2a	(PE 0601102F)

	Exh	nibit R-2a, F	RDT&E Pro	ject Justif	ication				DATE	February	2008
BUDGET ACT 01 Basic R	IVITY esearch			P 0 5	PE NUMBER AND 1601102F Defe Sciences	TITLE ense Researc	:h	PROJECT 2308 Pr	Opulsi	ER AND TITLE	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 20	013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estim	ate	Complete	
2308 Pro	opulsion	20.499	21.144	25.432	25.732	26.956	27.431	2	7.847	Continuing	TBD
Qu	antity of RDT&E Articles	0	0	0	0	0	0		0		
Propuls rockets space p propuls involve Non-ch space-b	sion basic research expounds fundan a, and combined cycle propulsion system ower and propulsion, high altitude s sion, and the synthesis of new chemi es the complex coupling between end memical energetics research includes based energy utilization. Primary are	nental knowled stems for future signature charac cal propellants. ergy release thre both plasma an as of research i	ge to enable an rapid global re- terization and These thrusts ough chemical d beamed-ener nvestigated by	d enhance effice each and on-de contamination, can be grouped reaction and the gy propulsion this project are	cient utilization mand space acc , propulsion dia d into reacting f he flow processe for orbit-raising e space power, p	of energy in ai eess. Basic Rese gnostics, therm lows and non-c es that transpor- g space mission propulsion, con	rbreathing eng earch thrusts in al managemen hemical energ t chemical rea s and ultra-hig abustion, and o	gines, che nclude air nt of space getics. Stu ctants, pro gh energy diagnostic	mical a breathi e-based dy of re oducts, technic cs.	and non-chemic ing propulsion, l power and eacting flows and energy. ques for	al
(U) <u>B. Acc</u> (U) MAJC miniat	complishments/Planned Program DR THRUST: Research and model s turization, and contamination/signate	(\$ in Millions) space propulsio ure.	n and power in	the areas of cl	hemistry, electro	onics,	<u>F</u> Y	<u>7 2007</u> 8.786		<u>FY 2008</u> 9.054	<u>FY 2009</u> 11.695
(U) In FY pulsed combu magne superc	2007: Conducted research on plasm d detonation rocket engines and othe ustion instabilities. Investigated high etohydrodynamic (MHD) flow contr conducting magnet capability for MI	na-based, charg r new engine co a altitude plume ol to optimize s HD flow contro	ed droplet base oncepts. Exami s signature and cramjet flow p l of advanced e	ed, and beamed ned methods to l contamination wath performance engines.	l-energy thruste o predict and su n. Investigated ce. Investigated	rs. Investigated ppress lightweight	I				
(U) In FY dynan condit techni Contin electro that ca flexibi	2008: Conduct studies of small sate nics in these thrusters. Evaluate meth tions, and develop research models t ques for characterization of combus nue to investigate high altitude plum omagnetic forces as a rail-gun or coi an achieve the simultaneous objectiv ility and scope.	ellite, microsate nods to predict a hat can be incon tion instabilities es signature and l-gun. Conduct res of increasing	ellite, and nano and suppress co rporated into the s in high pressu d contaminatio research to ena g payload and/o	satellite propul ombustion inst ne design codes ure, harsh, option n. Investigate a able revolution or time in orbit	lsion and invest abilities under s s. Develop nove cally thick envi alternate launch ary designs of s and increasing	igate plasma supercritical el diagnostic ronments. systems using satellite systems mission	5				
(U) In FY dynan invest level r	2009: Continue studies of small sat nics in these thrusters. Continue to in igating alternate launch systems usin research that leads to the introduction	tellite, microsat nvestigate high ng electromagno n of novel mult	ellite, and nano altitude plumes etic forces. Con i-use technolog	osatellite propu s signature and nduct fundame gies and concep	Ision and invest contamination. ntal component ots in order to ad	tigate plasma Continue and system chieve					
Project 2308				R-1 Line Ite	m No. 1 of 49					Exhibit R-22 (F	PE 0601102E)
110,001 2000				33							

	Exhibit R-2a, RDT&E Projec	D/	February	/ 2008	
BUD(01 B	ET ACTIVITY asic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2308 Prop	UMBER AND TITLE	1
(U)	B. Accomplishments/Planned Program (\$ in Millions) multi-functional satellite architectures and the development of highly efficie (e.g., micro electro-mechanical turbines and nano-structured thermoelectric management or spacecraft structure. Enhance novel diagnostic techniques for instabilities in high pressure, harsh, optically thick environments.	ent power generation/recovery systems units) deeply integrated with thermal or characterization of combustion	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Explore combustion, propulsion, and diagnostics in sub Investigate multi-phase, turbulent reacting flows to improve the performance turbines, ramjets, scramjets, pulsed detonation engines, and rockets. Starting support of a higher Air Force priority Energy Conservation -Assured Fuels I technologies that enable the use of domestic fuel sources for military energy	psonics, supersonics, and hypersonics. e of propulsion systems, including gas g in FY 2008, conduct basic research in Initiative to identify and develop y needs.	8.886	11.096	13.737
(U)	In FY 2007: Improved laser diagnostic measurement capabilities in the char Investigated molecular transport effects causing and enhancing thermal dest supercritical thermodynamic conditions. Incorporated prediction methodolog accurate and computationally tractable, into turbulent combustion models. E plasmas are used to improve aerodynamic characteristics and propulsive effi propellants that are more energetic, environmentally benign, and less sensiti strategies for using alternate hydrocarbon fuels based on the incorporation o eddy simulations.	racterization of turbulent reacting flows. abilization of hydrocarbon fuels under gies, which are both quantitatively Enhanced scientific bases for how iciencies. Investigated fuels and ve to accidental detonations. Formulated of detailed chemistry models into large			
(U)	In FY 2008: Continue improving laser diagnostic measurement capabilities, effects causing and enhancing thermal destabilization of hydrocarbon fuels u conditions, and prediction methodologies, which are both quantitatively accuturbulent combustion models. Further enhance scientific bases for how plasm characteristics and propulsive efficiencies. Expand strategies for using altern incorporation of detailed chemistry and transport models through surrogate provide fuel-flexible energy conversion technology in support of the Energy	, investigations of molecular transport under supercritical thermodynamic urate and computationally tractable, for mas are used to improve aerodynamic nate hydrocarbon fuels based on the fuel representations. Conduct research to 7 Conservation-Assured Fuels Initiative.			
(U)	In FY 2009: Continue improving laser diagnostic measurement capabilities, effects causing and enhancing thermal destabilization of hydrocarbon fuels u conditions, and prediction methodologies, which are both quantitatively accuturbulent combustion models. Continue exploring the scientific bases for ho aerodynamic characteristics and propulsive efficiencies. Exploit strategies for inserting reduced fuel representations into comprehensive combustion mode				
Pro	ect 2308	R-1 Line Item No. 1 Page-34 of 49		Exhibit R-2a	(PE 0601102F)
		34			

		Exhibit R-	2a, RDT&E	Project Jus	stification			Γ	February	2008	
BUD 01	GET ACTIVITY Basic Research				PE NUMBER A 0601102F D Sciences	ND TITLE efense Resea	rch	PROJECT NUMBER AND TITLE 2308 Propulsion			
(U)	B. Accomplishments/Planned H support of the Energy Conservation of current and future alternative f conversion characteristics of the	Program (\$ in Mil on-Assured Fuels fuels through chem base fuels.	lions) Initiative, ident iically simplifie	ify surrogate fue d chemical com	els that will repre pounds that retai	esent the behavio in the energy	DE	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Coa In FY 2007: Conducted research In FY 2008: Not Applicable. In FY 2009: Not Applicable.	l-Based Jet Fuels. to produce coal-b	ased jet fuels. A	Assess military u	utility and suitab	ility of this fuel.		2.827	0.000	0.000	
 (U) (U) (U) (U) (U) 	CONGRESSIONAL ADD: Coa In FY 2007: Not Applicable. In FY 2008: Conducted research In FY 2009: Not Applicable	l Transformation I to produce domes	Laboratory. tic sources of bi	ofuels and coal-	based fuels.			0.000	0.994	0.000	
(U) (U)	Total Cost							20.499	21.144	25.432	
(U)	C. Other Program Funding Sun	nmary (\$ in Millio	<u>ons)</u>								
		<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 20</u> <u>Estim</u>	13Cost toateComplete	<u>Total Cost</u>	
(U) (U) (U)	Related Activities: PE 0602102F, Materials. PE 0602203F, Aerospace Propulsion										
(U)	PE 0602500F, Multi-Disciplinary Space Technology.										
(U)	PE 0602601F, Space Technology.										
	Structures.										
	Not Applicable.										
Pro	oject 2308			R-1 Line Page	e Item No. 1 9-35 of 49				Exhibit R-2a	(PE 0601102F)	
					35						

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication				DATE	February	2008
BUDGET ACTIVITY 01 Basic Research				P 0 5	PE NUMBER AND 0601102F Def 6ciences	TITLE ense Researd	ch	PROJEC 2311 In	T NUME	BER AND TITLE	S
Cost (\$ ir	Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2	.013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estin	nate	Complete	
2311 Information Science	ces	26.008	25.257	31.640	32.512	36.241	38.062	; 3	39.045	Continuing	TBD
Quantity of RD1&	E Articles	U Space and Info	U mation Salari	U U	U U	U	U Secon Enviror		0	ma married to De	
in this PE to more accurately	align basic research	b efforts in Phy	sice		lation sciences.	ШТТ 2008,	Space Environ	innent en	ons we	Te moved to FI	0ject 2501
Information sciences b targeting (or strike), an distribution, and (3) co interlocking systems co are those in networks a occurring in the follow signals and control of l	asic research genera d improved battlesp nversion of information onnected by network nd communications, ing areas: information arge systems.	tes fundamenta ace awareness. tion into knowle s leading to a s , software, infor on operations no	l knowledge ar Areas of resea edge to suppor ystem of syster mation manag etwork, softwa	nd understandir rch focus are (1 t decision maki ms architecture ement, and hur re, and system	ng to support cr. 1) access to disp ing. The data, fr e. Areas of rese man-system inte architectures; in	itical Air Force parate data and usion engines, a arch underpinn eractions. Com nformation fusi	capabilities in information, (and command ing these team plementing th ion; information	n informa 2) inform and cont n-focused ese overa on forensi	ation sup nation f rol func l, netwo all focus ics; con	periority, preci fusion and ctions reside on ork-enabled sys s areas, researc nmunications a	sion 1 tems h is 1nd
 (U) B. Accomplishments (U) MAJOR THRUST: Ferrer phenomena, space were observation, better spreiforts previously in transcription of the phenomena, space were observation, better spreiforts previously in transcription. (U) In FY 2007: Expanded detection, spectral restrict telescopes. Developed advanced modeling terms 	Planned Program desearch space envir ather, magneto/iono ace-based communic his Major Thrust we vsics. d development of ground olution, nanotechnol space-based sensor chniques. Explored	(\$ in Millions) ronment to impr sphere effects, a cations, and the re moved into H round-based op logy, and advan technology. Ex advanced mode	ove solar plas space debris, a quantifying of Project 2301 in tical telescope ced signal-pro splored the sola ling algorithm	na theories and daptive optics f risks to space this PE to mor technologies (i cessing algorith ar interior as a s to take advan	I modeling in th for improved sp systems. Note: re accurately ali i.e., adaptive op hms) to include complex system tage of increase	e areas of solar pace In FY 2008, gn basic tics, photon radio n through ed computer	<u>F</u>)	<u>¥ 2007</u> 8.893		<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
power and speed, and understanding of func protection of space as processes in the magr processes controlling DoD surveillance and (C/NOFS-SMEI) sate neutral winds above 1	to seek improved pl amental processes o sets. Investigated so etosphere, ionosphe space plasma to imp the Communication llites to improve ren 50 kilometers. Emp	lasma models to of energetic part lar processes ar re, and thermos prove ability to the ns/Navigation O note sensing of loyed all-sky in	enhance unde icle scattering id energetic evo phere. Searche forecast near-E utage Forecast interplanetary naging to study	erstanding of ba in the near-Ear ents, the solar we d for understar earth space envi- ting System-So space. Initiated of ionospheric	asic plasma theo rth environment wind, and fundan nding of fundan ironment. Analy olar Mass Ejection l research to invo c plasma phenor	ory. Developed to support amental nental yzed data from on Imager vestigate the mena and					
Project 2311				R-1 Line Ite Page-36	em No. 1 of 49					Exhibit R-2a (I	PE 0601102F)

	Exhibit R-2a, RDT&E Project Justifi	DA	February	/ 2008	
BUD(01 B	GET ACTIVITY PE asic Research 00 Si	E NUMBER AND TITLE 601102F Defense Research ciences	PROJECT N 2311 Info	UMBER AND TITLE	es
(U)	B. Accomplishments/Planned Program (\$ in Millions) develop techniques to quantify these observations.		<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: Explore basic mechanisms to realize gains in innovative transform technologies, thereby enabling the Air Force to enhance its dominance communications	ational communications using the space medium.	0.993	0.994	1.000
(U)	In FY 2007: Investigated innovative methods for optical communications such as partial modulation, and liquid crystal spatial modification techniques. Explored the basic mech	al coherence, polarization nanisms of dual polarization			
(II)	antennas for space applications. In EV 2008: Define the details of the investigation that partially cohorent leser beams a	ra lass disturbed by passage			
(0)	through turbulent atmospheres than their classically coherent counterparts. Pursue the d which can emit such partially coherent beams. Continue to investigate the possibility th	lesign of solid state lasers at the long distance stability			
	of polarization states can be exploited to communicate digitized messages.	-			
(U)	In FY 2009: Contiune to study and refine results of selected solid state partially cohere	nt laser designs together with			
	the propagation of partially coherent laser beams through surrogate turbulent media. Me to verify the predicted long distance stability.	onitor the polarization states			
(U)					
(U)	MAJOR THRUST: Investigate signal communications, surveillance, and targeting for improved command and control for the battlefield commander. Efforts include research generalized functions and probability harmonic methods, and asymptotic expansions	increased awareness and in linear operator theory,	4.667	5.378	7.055
(U)	In FY 2007: Explored data fusion science to enable rapid data conversion across multip conceptualized information. Studied methodologies for evaluating the performance of m	ple bands into graphical and new wireless mobile,			
	networked communications systems. Studied and assessed technical alternatives for fea	sibility of super-resolution			
	millimeter and search and rescue imagery. Investigated the hybrid radio-frequency/free- refined the parameters of other innovative technologies to attain ultra-fast, reliable infor- ultra-wide hand transmission technology for hyperspectral and other diverse data	-space optical paradigm and rmation exchange. Developed			
an	In FY 2008: Focus on integrating results in distributed navigation geo-location and in	teractive telemetry to			
(0)	improve the collecting and interpreting of battlespace information, with emphasis place changing warfare scenarios. Continue to study methodologies for evaluating the perform	d on dealing with diverse,			
	mobile networked communications systems. Continue study and assessment of technic	al alternatives for feasibility			
	of super-resolution millimeter and search and rescue imagery. Continue to investigate th	he hybrid			
Pro	R-1 Line Iten	n No. 1		Exhibit P-23	(PE 0601102E)
110	.37				

Exhibit R-2a, RDT&E Project Justification		DATE February 2008		
BUDGET ACTIVITY PE NUMBER AND TO 0601102F Defe Sciences	TITLE PROJI nse Research 2311	ECT NUMBER AND TITLE Information Sciences		
 B. Accomplishments/Planned Program (\$ in Millions) radio-frequency/free-space optical paradigm and refine the parameters of other innovative technologies ultra-fact reliable information exchange 	FY 2007 s to attain	<u>FY 2008</u> <u>FY 2009</u>		
 (U) In FY 2009: Study navigation approaches such as "optical flow field" to improve understanding of the for over-arching methodologies that integrate sensing data collected by distributed, inter-communicating sensor resources. Continue to develop ultra-wide band transmission technology for hyper-spectral and data. Continue to study methodologies for evaluating the performance of new wireless mobile, network communications systems. Continue study and assessment of technical alternatives for feasibility of sup millimeter and search and rescue imagery. 	foundation ng networks of other diverse ked per-resolution			
 (U) (U) MAJOR THRUST: Conduct research in complex systems and algorithms for highly flexible, reliable, rich information systems supporting battlefield commanders using artificial intelligence, information w techniques, intelligent agents, knowledge bases, distributed systems, machine learning, uncertainty reasonable of the systems. 	secure, and 11.455 varfare soning, and	18.885 23.585		
 (U) In FY 2007: Developed information operations science techniques to exploit information intensive sys networks. Developed information fusion science to provide deep, adaptive, expert decision support. Ex quantum and bio-computing techniques and algorithms to allow enhanced tracking, recognition, and ch to improve situational awareness, command and control, and security. Investigated first principles of sc architectures including characteristic property metrics and begin development of automatic software ar analysis tools. 	stems and ploited naracterization oftware system chitecture			
 (U) In FY 2008: Significantly increase investigation of first principles of software system, network, and in system architectures including characteristic properties and metrics, and begin development of automat architecture analysis tools. Add research on brilliant software agents and other techniques for informati knowledge mining, and to improve situational awareness and command and control. Continue evolving operations science techniques to exploit information intensive systems and networks. Further develop i fusion science to provide deep, adaptive, expert decision support. 	formation tic software ion operations, g information information			
 (U) In FY 2009: Continue to increase emphasis on investigating first principles of software system architecture including characteristic properties and metrics, and begin development of automatic software architecture tools. Continue research on brilliant software agents and other techniques for information operations, k mining, and to improve situational awareness and command and control. Continue to develop informat science techniques to exploit information intensive systems and networks. Continue developing information science to provide deep, adaptive, expert decision support. 	ctures ure analysis nowledge ion operations ation fusion			
R-1 Line Item No. 1 Project 2311 Page-38 of 49		Exhibit R-2a (PE 0601102F)		

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD 01	GET ACTIVITY Basic Research				PE NUMBER A 0601102F D Sciences	ND TITLE efense Resea	rch	PROJECT NUM 2311 Inform	BER AND TITLE ation Science	es
(U) (U)	B. Accomplishments/Planned P	rogram (\$ in Mil	<u>lions)</u>				F	<u>Y 2007</u> 0.000	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U)	Total Cost							26.008	25.257	31.640
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons)</u>							
		<u>FY 2007</u>	<u>FY 2008</u>	FY 2009	<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>	<u>Complete</u>	<u>100010000</u>
(U) (U)	PE 0602500F, Multi-Disciplinary Space Technology.									
(U)	PE 0602601F, Space Technology.									
(U)	PE 0602702F, Command,									
an	PE 0603410F Space System									
	Environmental Interactions									
(U)	PE 0603500F,									
	Multi-Disciplinary Advanced Development Space Technology.									
(U)	D. Acquisition Strategy Not Applicable.									
Pro	oject 2311			R-1 Lin Page	e Item No. 1 -39 of 49				Exhibit R-2a	(PE 0601102F)
					39					

Ext	nibit R-2a, F	RDT&E Pro	oject Justif	ication			DATE	February	2008
BUDGET ACTIVITY 01 Basic Research			F	PE NUMBER AND 0601102F Defe Sciences	TITLE ense Researd	ch	PROJECT NUME 2312 Biologi	BER AND TITLE	
Cost (§ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2312 Biological Sciences	9.682	10.332	10.473	10.601	10.444	10.230	10.120	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		
induced by chemical and physical agents, e exploit biological properties to control and (lasers and microwaves) with human tissue materials and directed energy systems, and biomimetic sensors strives to mimic the bio biocatalysis characterizes and bioengineers the mimicking of natural materials, using o taking existing biomaterials/organisms and biomineralization. Research in biointerfaci- the biotic-biotic or the biotic-abiotic interface	manipulate operations manipulate operations innovation of the ological detection cellular enzymorganisms as bio using them as the al science is focuse. Research in	sensors based prational enviro d effects to ena- piotechnologies on systems of c es to biosynthe material factor novel materials used on new b biophysical m	on biomimicry onments. Resea able safety asse s to enhance th organisms at th esize renewabl ries of new ma s like viral grac biosensors and nechanisms will	y, biomolecular i arch topics are for essment strategie he physiological he molecular leve e hydrogen fuel terials, genetica dients or process bionanotechnolo Il look to discov	materials, block bocused on the i es, hazard-free performance and el in developing from sunlight a lly altering exis- sing them furth bogy, and specifi er and understa	nromatics, and nteractions of development a nd protection of g novel man-m and water. Res sting organism er to make a us ically addresse and basic biolo	chemicals and p and use of future of Air Force per nade sensors. Ba search in biomat se for new mater seful material as es the fundamen ogical mechanism	obysical agents e air and space sonnel. Research asic research in terials focuses of rials capabilities s in tal science at ei ms that could b	ch in on s, or ither e
 (U) <u>B. Accomplishments/Planned Program</u> (U) MAJOR THRUST: Characterize, underst organisms by chemical and physical agent nano-energetic materials, and directed energenable photosynthetic microbes to use light Explore biomolecular profiles and hormet negative inhibitory) biological responses i such low-dose positive stimulation in indu toxicity. (U) In FY 2007: Validated biokinetics models pulmonary exposures to fuel mixtures. Apresponses induced by the interactions of d Utilized biocatalysis techniques and genet by drogen by photosynthetic microbes. In 	(\$ in Millions) and, predict, co ts of Air Force s ergy. Identify, c the energy for the ic mechanisms induced by low- icing a protective s used to predic oplied methodol irected energy a tic engineering	ntrol, and engi significance, su haracterize, an e renewable ge involved in the doses of toxic ve state in tissu t the fuel consu- ogies for profi- and nano-energo principles to el omolecular pr	ineer biomolec uch as alternate d engineer nov eneration of hy e positive stim- agents and inv ie that is resistant tituent levels in ling and mode getic materials licit the water-lo ofiles for unde	sular responses in e synthetic jet fu yel enzymatic pr drogen fuel from ulatory (rather the vestigate the imp ant to subsequer in tissues followi ling the biomole with biological based generation	nduced in pels, operties that n water. nan the plications of at high-dose ng dermal and ecular systems. n of fuel-cell	<u>F</u> Y	<u>7 2007</u> 5.534	<u>FY 2008</u> 5.836	<u>FY 2009</u> 5.906
with positive stimulatory or "hormetic" re-	sponses of biolo	ogical systems	R-1 Line Ite Page-40	ry low-levels of em No. 1 of 49	known toxic			Exhibit R-2a (I	PE 0601102F)

	Exhibit R-2a, RDT&E Proje	DA	February	/ 2008	
BUDG 01 B	BET ACTIVITY asic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2312 Biol	UMBER AND TITLE	3
(U)	B. Accomplishments/Planned Program (\$ in Millions) substances and bazardous radiation		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Refine whole animal biokinetic models predicting tissue disp- iterative experimental input derived from laboratory animal exposures and methodologies to acquire in vitro and in vivo data from biological systems possessing varying physical and chemical properties. By using recently imp molecular profiling and characterization of biological systems responding to generated from laser and microwave sources. Continue bio-prospecting for bio-engineering and directed-evolution experiments aimed at enhancing the protons to the hydrogen-generating enzyme. Continue to utilize state-of-the collect, and analyze date with regard to low-dose chemical and radiation ex- pathwave and profiles mediating the responses to the exposures.	osition of fuel components based on analyses. Begin to apply newly developed exposed to nano-scale structures proved methodologies, begin the to high and low doses of directed energy hydrogen-generating microbes and begin e photosynthetic flow of electrons and e-art tools and techniques to explore, sposure effects and the molecular			
(U)	In FY 2009: Begin to integrate individual computational models characteri lung and absorption through skin into animal biokinetic models for predicti fuel components. Continue to collect data from biological systems exposed data base of responses for future predictive modeling studies based on physi- nanostructures. Continue collecting directed energy dose-response data and unique biomolecular profiles responding to specific levels of radiant exposs bio-engineering, and directed-evolution approaches to the generation of hy and begin metabolic engineering research to identify and eliminate pathway equivalents away from the hydrogen-generating apparatus. Continue utilizi explore, collect, and analyze date with regard to low-dose chemical and rad pathways and profiles mediating the responses to the exposures.	zing multi-component fuel deposition in ing whole animal disposition of single I to nano-materials and begin to develop a sico-chemical properties of various I begin bioinformatics analyses to identify ure. Continue bio-prospecting, drogen fuel by photosynthetic microbes ys that drain unnecessary energy ng state-of-the-art tools and techniques to diation exposure effects and the molecular			
(U)					
(U) (U)	MAJOR THRUST: Explore biomimetics, biomaterials, and biointerfacial sensors, engineering processes, and mechanisms, and the synthesis of nove sensor modalities, explore surface-mediated process, and delve into extrem biophysical mechanisms will look to discover and understand basic biologi either harden or repair bio-based devices or can utilize complex, impure bio In FY 2007: Investigated, evaluated, modeled, and mimicked biological pr applications in near-ambient temperature sensing devices, and added predational sensitive devices of the	sciences to enable development of novel el materials, as well as to research new e environmental conditions. Research in cal mechanisms that could be used to ofuels for compact power. rocesses and designs for future tor avoidance and new prey detection	4.148	4.496	4.567
	schemes as future technology areas. Probed and manipulated biochromoph	ores and biophotoluminescent			
Proje	ect 2312	R-1 Line Item No. 1 Page-41 of 49		Exhibit R-2a	(PE 0601102F)

		DATE	DATE February 2008							
BUD(01 E	GET ACTIVITY Basic Research				PE NUMBER A 0601102F D Sciences	ND TITLE efense Resear	ch	PROJECT NUM 2312 Biolog	BER AND TITLE	i
(U)	B. Accomplishments/Planned characteristics in microbial and biomaterial and biointerfacial sc and elucidate bionanotechnolog modality. Expanded into extrem temperature organisms.	Program (\$ in Mil protein-based biosy iences to control ce y applications. Rese ophile research to a	lions) estems for applie ellular systems t earched surface access biosynthe	cations to militar o synthesize nov mediated cellula etic pathways not	y sensor system el materials, ev r differentiation t achievable wit	s. Exploited aluate biosensors as a new sensor h room	<u>F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Initiate work on manipulating materials to mimic the desirable properties found in skin for maintenance, self-healing, and repair. Continue to investigate predator avoidance and new prey detection schemes as future technology areas. Further probe and manipulate biochromophores and biophotoluminescent characteristics in microbial and protein-based biosystems for applications to military sensor systems. Continue to exploit biomaterial and biointerfacial sciences to control cellular systems to synthesize novel materials, evaluate biosensors, and elucidate bionanotechnology applications. Research surface mediated cellular differentiation as a new sensor modality. Continue investigations in extremophile research to access biosynthetic pathways and materials not achievable with room temperature organisms. Continue work in biophysical mechanisms to discover and understand the basic underlying biological mechanism that could be used to either harden or repair bio-based devices or can utilize complex, impure biofuels for compact power.									
(U) (U)	In FY 2009: Continue work on maintenance, self-healing and re- future technology areas. Further microbial and protein-based bio and biointerfacial sciences to co elucidate bionanotechnology ap modality. Continue investigation achievable with room temperatu the basic underlying biological n utilize complex, impure biofuels Total Cost	manipulating mater epair. Expand inves probe and manipul systems for applica ntrol cellular system plications. Research is in extremophile re organisms. Cont nechanism that cours for compact powe	rials to mimic the tigating predato ate biochromop tions to military ns to synthesize a surface mediate research to acce inue work in bio and be used to eit r.	te desirable prop r avoidance and hores and biopher sensor systems. novel materials ted cellular differ ss biosynthetic p ophysical mecha ther harden or re	erties found in s new prey detect otoluminescent Continue to ex evaluate bioser rentiation as a n athways and ma nisms to discov pair bio-based o	kin for ion schemes as characteristics in ploit biomaterial nsors, and ew sensor aterials not er and understand levices or can	1	9.682	10.332	10.473
(U)	C. Other Program Funding Su	mmary (\$ in Millid	ns)							
(U) (U)	Related Activities: PE 0602202F, Human	<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Dre	inct 0010			R-1 Line	e Item No. 1				Evhikit D. O.	
Pro	Ject 2312			Page	-4∠ 0⊺ 49 42				Exnidit R-2a (PE 0601102F)

Exhibit R-2a, RDT&	E Project Justification	DATE February 2008
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT NUMBER AND TITLE 2312 Biological Sciences
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Effectiveness Applied Research. (U) PE 0602204F, Aerospace Sensors. (U) PE 0602602F, Conventional Munitions. (U) PE 0602702F, Command, Control, and Communication. (U) <u>D. Acquisition Strategy</u> Not Applicable. 		
Project 2312	Page-43 of 49	Exhibit R-2a (PE 0601102F)

Budget ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 0'Basic Research 2313 Human Performance 2313 Human Performance 2313 Human Performance 12.161 11.052 15.255 18.065 19.200 FY 2010 FY 2010 FY 2011 FY 2013 Const (a model and a model and model and model and a model and a model and model and a model an		Exh	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DAT	E	2008
Cost (\$ in Millions) FY 2007 Actual FY 2008 Estimate FY 2010 Estimate FY 2011 Estimate FY 2012 Estimate FY 2013 Estimate Cost to Estimate Totic 2313 Hunan Performance 12.161 11.052 15.255 18.065 19.220 19.538 21.299 Continuing Quantity of RDT&E Articles 0 <th>BUDG 01 Ba</th> <th>et activity asic Research</th> <th></th> <th></th> <th>P 0 5</th> <th>PE NUMBER AND 1601102F Defe Sciences</th> <th>TITLE ense Researd</th> <th>ch</th> <th>PROJECT NU 2313 Huma</th> <th>MBER AND TITLE n Performance</th> <th>÷</th>	BUDG 01 B a	et activity asic Research			P 0 5	PE NUMBER AND 1601102F Defe Sciences	TITLE ense Researd	ch	PROJECT NU 2313 Huma	MBER AND TITLE n Performance	÷
2313 Human Performance 12.161 11.052 15.255 18.065 19.220 19.338 21.299 Continuing Quantity of RDT&E. Articles 0 </th <th></th> <th>Cost (\$ in Millions)</th> <th>FY 2007 Actual</th> <th>FY 2008 Estimate</th> <th>FY 2009 Estimate</th> <th>FY 2010 Estimate</th> <th>FY 2011 Estimate</th> <th>FY 2012 Estimate</th> <th>FY 2013 Estimate</th> <th>Cost to Complete</th> <th>Total</th>		Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
Quantity of RDT&E Articles 0 </td <td>2313</td> <td>Human Performance</td> <td>12.161</td> <td>11.052</td> <td>15.255</td> <td>18.065</td> <td>19.220</td> <td>19.538</td> <td>21.29</td> <td>9 Continuing</td> <td>TBD</td>	2313	Human Performance	12.161	11.052	15.255	18.065	19.220	19.538	21.29	9 Continuing	TBD
 (1) <u>A. Mission Description and Budget Item Justification</u> Human performance basic research seeks the fundamental knowledge needed to understand, measure, and optimize human capabilities critical to Air Force operations. Within this project, the special areas of scientific interest include Sensory Systems, Cognition and Decision, Homeostatic and Circadian Regulation of Human Performance, and Socio-Cultural Modeling. In all areas, experimental efforts are coordinated with mathematical or computational modeling. Air Force sensory research emphasizes human auditory capabilities, including 3D spatial hearing, multi-talker communication, speech intelligibility, and information amaking. Cognitive research emphasizes decision optimization in complex, dynamic tasks, including coordinated decision-making performed by networked, multi-person teams. Also aligned with Air Force reginitive research are efforts to determine how best to promote robust, reliable decision-making performation in adversarial decision-making performation in adversarial decision-making. The Air Force reliance on sustained human performance during trans-meridian operations and night operations motivates basic research efforts to predict and mitigate cognitive impairments from extended wake and much higher than normal workload periods. (1) MAJOR THRUST: Probe human sensory systems and perceptions critical for warfighter performance (auditory and visual processes, multi-sensory integration, and sensory biomimetics) to enhance human-machine interaction in Air Force weapon systems. Research biophysical and neural mechanisms to determine huma cognitive performance under conditions of sleep loss, sustained operations, and no-standard sleep/wake duty cycles. (1) In FY 2007: Conducted empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection. Exploited multi-sensory integration methods and novel biological sensing mechanisms. Probed bioph		Quantity of RDT&E Articles	0	0	0	0	0	0		0	
 (U) B. Accomplishments/Planned Program (\$ in Millions) (U) MAJOR THRUST: Probe human sensory systems and perceptions critical for warfighter performance (auditory and visual processes, multi-sensory integration, and sensory biomimetics) to enhance human-machine interaction in Air Force weapon systems. Research biophysical and neural mechanisms to determine human cognitive performance under conditions of sleep loss, sustained operations, and non-standard sleep/wake duty cycles. (U) In FY 2007: Conducted empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection. Exploited multi-sensory integration methods and novel biological sensing mechanisms. Probed biophysical mechanisms responsible for fatigue. Evaluated models of sleep/wake dynamics to predict specific consequences in the performance of an individual warfighter. Investigated the effects of ultrashort laser pulse on the eye (laser flash blindness). (U) In FY 2008: EXPloit multi-sensory integration methods and novel biological sensing mechanisms. Continue to probe biophysical mechanisms responsible for fatigue, including models of sleep/wake dynamics. Shift emphasis from acute to chronic sleep deprivation in order to predict specific consequences in the performance of individual warfighters. Refine models showing effects of ultrashort laser pulse on the eye (laser flash blindness). (U) In FY 2009: Engage new research methods to characterize requirements for optimal speech communication, 		Human performance basic research seeks th Within this project, the special areas of scie Performance, and Socio-Cultural Modeling research emphasizes human auditory capab Cognitive research emphasizes decision op Also aligned with Air Force cognitive resea algorithms for fusion, automation, and intel The Air Force reliance on sustained human cognitive impairments from extended wake	tinization in co arch are efforts ligent signal pr performance d and much high	knowledge net nclude Sensory sperimental eff g 3D spatial he omplex, dynam to determine h ocessing. Mod uring trans-me ner than norma	eded to underst v Systems, Cog forts are coordi earing, multi-ta ic tasks, includ ow best to pror eling efforts in ridian operatio l workload peri	tand, measure, a mition and Deci nated with math lker communica- ling coordinated mote robust, rela- iclude cultural f ns and night op iods.	and optimize hu sion, Homeosta nematical or con ation, speech in l decision-maki table decision-r actors that may erations motiva	iman capabiliti atic and Circac mputational m telligibility, ar ng performed naking through affect behavio ites basic resea	ies critical to lian Regulatio odeling. Air l nd informatio by networked h information or in adversar arch efforts to	Air Force operation of Human Force sensory nal masking. I, multi-person te -processing ial decision-making predict and mitig	ams. ing. gate
 mechanisms. Probed biophysical mechanisms responsible for fatigue. Evaluated models of sleep/wake dynamics to predict specific consequences in the performance of an individual warfighter. Investigated the effects of ultrashort laser pulse on the eye (laser flash blindness). (U) In FY 2008: Continue empirical research with mathematical and computational modeling in spatial audition, speech perception, and hearing protection. Prepare new understanding of speech recognition and acoustic noise for transition to hearing protection technologies. Exploit multi-sensory integration methods and novel biological sensing mechanisms. Continue to probe biophysical mechanisms responsible for fatigue, including models of sleep/wake dynamics. Shift emphasis from acute to chronic sleep deprivation in order to predict specific consequences in the performance of individual warfighters. Refine models showing effects of ultrashort laser pulse on the eye (laser flash blindness). (U) In FY 2009: Engage new research methods to characterize requirements for optimal speech communication, 	(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Probe human sensory visual processes, multi-sensory integration Force weapon systems. Research biophysi under conditions of sleep loss, sustained o In FY 2007: Conducted empirical research speech perception, and hearing protection.	(\$ in Millions) y systems and p h, and sensory b ical and neural perations, and p h with mathem . Exploited mul	erceptions criti biomimetics) to mechanisms to non-standard sl atical and comp ti-sensory integ	cal for warfigh enhance huma determine hum leep/wake duty putational mod gration method	ter performance an-machine inte nan cognitive p cycles. leling in spatial s and novel bio	e (auditory and raction in Air erformance audition, logical sensing	FY	<u>7 2007</u> 5.244	<u>FY 2008</u> 5.367	<u>FY 2009</u> 6.468
 (U) In FY 2009: Engage new research methods to characterize requirements for optimal speech communication, R-1 Line Item No. 1 	(U)	mechanisms. Probed biophysical mechani predict specific consequences in the perfor- laser pulse on the eye (laser flash blindness In FY 2008: Continue empirical research perception, and hearing protection. Prepar transition to hearing protection technologi sensing mechanisms. Continue to probe bi- sleep/wake dynamics. Shift emphasis from	sms responsible rmance of an in ss). with mathemat re new understa es. Exploit mu iophysical mech n acute to chro	e for fatigue. E dividual warfig ical and compu- anding of speec lti-sensory inte- nanisms respon nic sleep depri-	valuated mode ghter. Investiga attational model th recognition a gration method sible for fatigu vation in order	Is of sleep/wake ated the effects ling in spatial at and acoustic noi ds and novel bio te, including mo to predict speci	e dynamics to of ultrashort udition, speech ise for ological odels of fic				
	(U)	on the eye (laser flash blindness). In FY 2009: Engage new research method	dual warfighter	rs. Refine mod	ers showing eff s for optimal sp R-1 Line Ite	peech communi	cation,			Evhibit D 20 /	

	Exhibit R-2a, RDT&E Project Ju	stification	D	February	/ 2008
BUD(01 B	er Activity asic Research	PE NUMBER AND TITLE 0601102F Defense Research Sciences	PROJECT N 2313 Hun	UMBER AND TITLE	:e
(U)	B. Accomplishments/Planned Program (\$ in Millions) including modulation representation and filtering. Develop data, models, and algor masking in speech signals and in spatial audio displays. To inform the design of ne develop and test theoretical models for bone- and tissue-conducted cochlear excita To improve the ability to understand and forecast cognitive impairments during co conditions, employ new genomic and brain-monitoring methods to identify biomar Devise new, physiologically accurate quantitative models to elucidate mechanisms homeostatic recovery, and re-entrainment to circadian phase shifts (e.g., "jet lag").	ithms to minimize informational ew hearing protection systems, tion in high-noise environments. ntinuous high workload kers for individual susceptibility. of sleep/wake timing,	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Evaluate cognition and perception research to measure and an performance in complex, multi-interaction command and control tasks. Investigate theories of cognitive workload, alertness, and vulnerability to sleep loss. Discover beliefs that drive adaptive decision-making of interacting non-cooperative groups.	alyze dimensions of human behavioral and physiological dynamic models of attitudes and	5.162	5.685	8.787
(U)	In FY 2007: Developed quantitative models of individual and team information princluding applications to systems to improve the speed and accuracy of networked modeling individual and team training for the development of training systems opt teams, and applications. Assessed mechanisms for continuous learning and automa individuals. Developed models of symbolic spatial-imaginal processing. Explored error and optimize decision making under conditions of uncertainty and informatic	rocessing and decision-making teams. Employed progress on imized for specific individuals, ited, diagnostic mentoring of measures to avert/mitigate human on overload.			
(U)	In FY 2008: Continue to refine quantitative models of individual and team inform decision-making for application to systems for improving speed and accuracy of de progress on modeling individual and team training for the development of training individuals, teams, and applications. Assess mechanisms for continuous learning a mentoring of individuals to enable human and machine collaboration. Continue ex human error and optimize decision making under conditions of uncertainty and inf cognitive process modeling to include socio-cultural influences in competitive or r	ation processing and ecisions networked teams. Employ systems optimized for specific nd automated, diagnostic ploring measures to avert/mitigate ormation overload. Increase ion-cooperative environments for			
(U)	In FY 2009: Specific research objectives include the development of mathematica characterize important aspects of human cognitive performance in situations applic environments. The goal is to optimize human information-processing, problem-sol for individual war fighters and for networked, collaborative teams. Research will preasoning under uncertainty, algorithms for information integration and fusion, and	l and computational models to cable to Air Force operational ving, and decision making, both robe human inference and l new approaches to ensure robust			
Proj	ect 2313 R-1 Lin Pag	e Item No. 1 e-45 of 49		Exhibit R-2a	(PE 0601102F)

BUDGET ACTIVITY 01 Basic Research 10 B. Accomplishments/Planned Program (5 in Millions) decision-making under continuous, extended daty and under rapidly changing, adversarial conditions. Continue to refine agent based modeling and game theory, to include socio-cultural influences in competitive or non-cooperative environments for successful response to and prediction of adversary actions. New efforts will promote errors-disciplinary contributions from brain science, operations research, network theory, and computer science. (U) (U) CONGRESSIONAL ADD: Virtual Teleoperations for Unmanned Aerial Vehicles. (U) CONGRESSIONAL ADD: Virtual releoperations for Unmanned Aerial Vehicles. (U) Total Cost (U) Total Cost (U) Total Cost (U) Total Cost (U) Total Cost (U) Total Cost (U) FE 06027020F. Human Effectiveness Applied Research. (U) PE 0602702F. Command, Control, and Communication. (U) D. Accutation Strategy Not Applicable. (I) PE 0602702F. Command, Control, and Communication. (U) D. Accutation Strategy Not Applicable. (I) PE 0602702F. Command, Control, and Communication. (U) D. Accutation Strategy Not Applicable. (I) P. Control Process Applied Research. (E) P. Control Process Applied			Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
(I) B. Accomplishments/Planned Program (S In Millions) decision-making under continuous, extended duty and under rapidly changing, adversarial conditions. Continue to refine agent-based modeling and game theory, to include socio-cultural influences in competitive or non-cooperative environments for successful response to and prediction of adversary actions. New efforts will promote cross-disciplinary contributions from brain science, operations research, network theory, and computer science. 1.755 0.000 0.000 (I) In FY 2007: Conducted research on virtual reality technology to allow a single operator to simultaneously monitor and control multiple unmanned aerial vehicles remotely. 1.755 0.000 0.000 (I) In FY 2007: Not Applicable. 12.161 11.052 15.255 (I) FY 2007 FY 2008 FY 2009 FY 2011 FY 2012 FY 2013 Cost to 2.000 Total Cost (I) Rolated Activities: 10.052 FY 2008 FY 2009 FY 2010 FY 2012 FY 2013 Cost to 2.000 Total Cost (I) Related Activities: 10.95 Estimate Estimate Estimate Estimate Complete Total Cost (I) PE 0602/202F, furman Effectiveness Applicable. FY 2008 FY 2009 FY 2014 FY 2012 FY 2013 Cost to 2.000 FY 2014	BUD 01 E	GET ACTIVITY Basic Research				PE NUMBER A 0601102F D Sciences	ND TITLE Pefense Resea	rch	PROJECT NUN 2313 Humai	ABER AND TITLE n Performanc	e
(U) CONGRESSIONAL ADD: Virtual Teleoperations for Unmanned Aerial Vehicles. 1.755 0.000 0.000 (U) In FY 2007: Conducted research on virtual reality technology to allow a single operator to simultaneously monitor and control multiple unmanned aerial vehicles remotely. 1.755 0.000 0.000 (U) In FY 2007: Conducted research on virtual reality technology to allow a single operator to simultaneously monitor and control multiple unmanned aerial vehicles remotely. 11.152 0.000 0.000 (U) In FY 2008: Not Applicable. 12.161 11.052 15.255 (U) Total Cost 12.161 11.052 15.255 (U) Related Activities: FY 2007 FY 2008; FY 2009 FY 2010 FY 2012 FY 2013 Cost to (U) Related Activities: 10 PE 0602702F, Human Effectiveness Applied Research. 10 PE 0602702F, Command, Control, and Communication. 10 D. Acquisition Strategy Not Applicable. 10 P. Acquisition Strategy Not Applicable. R-1 Line Item No. 1 Project 2313 Project 240 of 49 Exhibit R-2a (PE 0601102F)	(U) (U)	B. Accomplishments/Planned Pr decision-making under continuous refine agent-based modeling and g environments for successful respon cross-disciplinary contributions fro	ogram (\$ in Mil , extended duty a , ame theory, to ir nse to and predic om brain science	llions) and under rapidl aclude socio-cul tion of adversar , operations rese	y changing, adv tural influences y actions. New e arch, network th	ersarial conditio in competitive o efforts will prom neory, and comp	ns. Continue to r non-cooperativ tote uter science.	7e	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Total Cost 12.161 11.052 15.255 (U) C. Other Program Funding Summary (\$ in Millions) FY 2007 FY 2008 FY 2010 FY 2011 FY 2012 FY 2013 Cost to. Total Cost (U) Related Activities: Actual Estimate Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Cost Total Cost (U) PE 0602202F, Human Effectiveness Applied Research. Effectiveness Applied Research. Control, and Communication. Op PE 0602702P, Command, Control, and Communication. (U) D. Acquisition Strategy Not Applicable. R-1 Line Item No. 1 Project 2313 Page-46 of 49 Exhibit R-2a (PE 0601102F)	(U) (U) (U) (U)	CONGRESSIONAL ADD: Virtua In FY 2007: Conducted research of and control multiple unmanned aer In FY 2008: Not Applicable. In FY 2009: Not Applicable.	al Teleoperations on virtual reality rial vehicles rem	s for Unmanned technology to al otely.	Aerial Vehicles llow a single ope	erator to simulta	neously monitor		1.755	0.000	0.000
C. Other Program Funding Summary (\$ in Millions) FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Total Cost (U) Related Activities: (U) PE 0602202F, Human Estimate Estimate Estimate Estimate Complete Total Cost (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602702F, Command, Control, and Communication. (U) D. Acquisition Strategy Not Applicable. Not Applicable.	(U)	Total Cost							12.161	11.052	15.255
Project 2313 Page-46 of 49 Exhibit R-2a (PE 0601102F)	(U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0602702F, Command, Control, and Communication. D. Acquisition Strategy Not Applicable.	<u>mary (\$ in Milli</u> <u>FY 2007</u> <u>Actual</u>	ons) <u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u> R-1 Line	<u>FY 2010</u> <u>Estimate</u>	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
	Pro	ject 2313			Page	e-46 of 49		1		Exhibit R-2a	(PE 0601102F)

	Ext	nibit R-2a, F	DT&E Pro	ject Justifi	cation			D	ATE February	2008
BUDGI 01 Ba	T ACTIVITY sic Research			PI 0 S	E NUMBER AND 601102F Defe ciences	TITLE ense Researc	:h	PROJECT N 4113 Exte Interface	NUMBER AND TITLE Ernal Research F	Programs
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 201	3 Cost to	Total
4113	External Desearch Drograms Interface	Actual	Estimate 11 046	Estimate 0.835	Estimate 0.813	Estimate 0 500	Estimate 0.038	Estimat	e Complete	
4115	Quantity of RDT&E Articles	0	0	9.833	9.813	9.399	<u> </u>	10	0	
an /	Mission Description and Budget Item	 Justification	0	0	0	Ŭ		1	0	
s s a r s	upport and develop scientists and engineer cientific and engineering education benefi ttract talented scientists and engineers to a elationships with future coalition partners. erving institutions, and other minority inst	rs with an aware cial to the Air F ddress Air Forc This project als itutions.	eness of Air Fo orce, increase e needs. Interr so seeks to enh	the internation orce basic resear the awareness of national interact ance education	rch priorities. T of Air Force ba tions facilitate f al interactions	These profession sic research pri future interoper with historically	number and A nal interaction orities to the r ability of coal y black colleg	and collab research cor ition system es and univ	borations stimulate mmunity as a whole ns and foster rersities, Hispanic	e, and
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Foster international s international strategy mission. Identify and technology liaison missions of the Europe Aerospace Research and Development.	(\$ in Millions) cience and tech d obtain unique an Office of Ae	nology coopera foreign resear rospace Resea	ation by suppor ch capabilities t rch and Develo	ting the Air Fo through the inte pment and the	rce's ernational Asian Office of	<u>FY</u>	<u>7 2007</u> 4.354	<u>FY 2008</u> 4.766	<u>FY 2009</u> 5.435
(U)	In FY 2007: Provided centralized cooperation order to identify and maintain awareness of investments by influencing and acquiring technical briefs and publications on uniquities of high-level DoD delegations and provide organizations. Assisted in Air Force fiscal	ation expertise a of foreign science world-class scie e foreign resear ed primary inter commitments t	nd supported i ce and technolo entific research ch and research face to coordin o NATO-affili	nternational tec ogy development. Established and capabilities. So nate internation ated research in	chnology liaiso nts. Capitalized nd maintained a Supported intern al participation nstitutes.	n missions in l on foreign access to national visits a among DoD				
(U) (U)	In FY 2008: Continue to provide centralized missions in order to identify and maintain capitalize on foreign investments by influe maintain access to technical briefs and pull support international visits of high-level E participation among DoD organizations. Corresearch institutes. In FY 2009: Continue to provide centralized and the pr	zed cooperation awareness of for encing and acque blications on un DoD delegations Continue to assiss zed cooperation	expertise and oreign science iring world-cla ique foreign re and provide p at in Air Force expertise and	support interna and technology ass scientific re- esearch and rese rimary interface fiscal commitm support interna	tional technolo developments, search. Continue earch capabilitie e to coordinate nents to NATO tional technolo	gy liaison . Continue to ue to seek and es. Continue to international -affiliated gy liaison				
	missions in order to identify and maintain capitalize on foreign investments by influe	awareness of fo encing and acqu	iring world-cla	and technology ass scientific re	developments. search. Continu	. Continue to ue to seek and				
Proje	ct 4113			R-1 Line Iter Page-47 c	n NO. 1 of 49				Exhibit R-2a (PE 0601102F)
				47						

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD(01 E	GET ACTIVITY Basic Research				PE NUMBER / 0601102F I Sciences	and title Defense Resea	rch	PROJECT NUM 4113 Extern Interface	IBER AND TITLE al Research	Programs
(U)	B. Accomplishments/Planned Pr maintain access to technical briefs support international visits of high participation among DoD organiza research institutes.	ogram (\$ in Mil and publications -level DoD deleg ations. Continue t	lions) s on unique fore gations and prov to assist in Air F	ign research and vide primary inte Force fiscal com	research capab rface to coordir mitments to NA	ilities. Continue t ate international TO-affiliated) o	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Strengthen sc U.S., thereby strengthening Air Fo superior technical talent and forge	ience, mathemati orce technical cap Air Force Resea	ics, and enginee pabilities. Assur- rch Laboratory	ring research an e the Air Force o relationships wit	d educational in of continuing av th premiere scie	frastructure in the ailability of ntists.	e	4.022	7.180	4.400
(U)	In FY 2007: Supported science, n colleges and universities, includin other minority institutions. Increas community, while simultaneously research.	nathematics, and g historically blac ed awareness of identifying/recru	engineering res ck colleges and Air Force resea iting the best sc	earch and educa universities, His rch needs throug cientific talent to	tional outreach p panic serving ir shout civilian sc participate in c	programs at U.S. astitutions, and ientific ritical Air Force				
(U)	In FY 2008: Continue to support at U.S. colleges and universities, i and other minority institutions. In community, while simultaneously research.	science, mathema ncluding historic rease awareness identifying/recru	atics, and engine ally black colleg of Air Force re- iting the best sc	eering research a ges and universit search needs thre sientific talent to	nd educational ties, Hispanic se oughout civilian participate in c	outreach program rving institutions scientific ritical Air Force	15			
(U)	In FY 2009: Continue to support at U.S. colleges and universities, i and other minority institutions. In community, while simultaneously research. Note: \$3.0M erroneousl 2009 and out	science, mathema ncluding historic crease awareness identifying/recru y placed in this e	atics, and engine ally black colleg of Air Force re- iting the best so ffort for Science	eering research a ges and universit search needs three sientific talent to e Board support	nd educational ies, Hispanic se oughout civilian participate in c moved out of th	outreach program rving institutions scientific ritical Air Force is program in FY	15			
(U)	Total Cost							8.376	11.946	9.835
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons)</u>							
		<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	FY 2011 Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>	Total Cost
(U) (U)	Related Activities: PE 0601103D, University Research Initiative.									
Pro	ject 4113			R-1 Lin Page	e Item No. 1 -48 of 49				Exhibit R-2a	(PE 0601102F)
					48					

Exhibit R-2a, RDT&	E Project Justification	DATE February 2008
BUDGET ACTIVITY 01 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>		
 (U) PE 0602102F, Materials. (U) PE 0602201F, Aerospace Flight Dynamics. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602204F, Aerospace Avionics. (U) PE 0602204F, Hypersonic Technology Program. 		
 (U) PE 0602500F, Multi-Disciplinary Space Technology. (U) PE 0602601F, Space Technology. (U) PE 0602602F, Conventional Munitions. (U) PE 0602702F, Command, Control and Communication. 		
(U) D. Acquisition Strategy Not Applicable.		
Project 4113	R-1 Line Item No. 1 Page-49 of 49 49	Exhibit R-2a (PE 0601102F)

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PE NUMBER: 0601103F PE TITLE: University Research Initiatives

	Exhit	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDO 01 B	GET ACTIVITY Basic Research			PE 0	E NUMBER AND 601103F Univ	TITLE versity Resea	arch Initiative	es	-	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	111.803	119.938	125.949	130.938	135.960	140.507	146.001	Continuing	TBD
5094	4 University Research Initiatives	111.803	119.938	125.949	130.938	135.960	140.507	146.001	Continuing	TBD
(U)	A. Mission Description and Budget Item This program supports defense-related basis superiority; enhances and promotes the edu technologies; and assists universities in est fundamental component of this program is interdisciplinary efforts. Note: In FY 2008 Engineering Complex, \$1M for High Temp Research Intiatives. This program is in Bu	Justification ic research in a ucation of U.S. s ablishing superi the recognition 3, Congress adde perature Hydrog udget Activity 1,	wide range of s scientists and ex or instrumenta that future tecl ed \$2.4M for B gen and the Spa Basic Science	ccientific and en ngineers in disc tion capabilities nologies and to attlespace Redu ce Education C , because it fun	ngineering disc ciplines critical s needed to imp echnology exp ucing Military Consortium (SE ds scientific stu	iplines pertiner to maintaining prove the qualit loitations requir Decision Cycle C), \$2.4M for udy and experin	nt to maintainin , advancing, ar y of defense-re re highly coord s, \$1M for Fra Secure Grid Re nentation.	ng U.S. military nd enabling futu elated research linated and com- nk R. Seaver Se esearch, and \$85	technology are U.S. defense and education. certed multi- and cience and M for Universit	e A nd y
(U)	B. Program Change Summary (\$ in Mil	<u>llions)</u>								
							<u>FY 2007</u>	<u>FY</u>	2008	<u>FY 2009</u>
(U)	Previous President's Budget						115.035	104	.304	101.850
(U)	Current PBR/President's Budget						111.803	119	.938	125.949
(U)	Total Adjustments						-3.232	15	.634	
(U)	Congressional Program Reductions									
	Congressional Rescissions							-0	.766	
	Congressional Increases							16	6.400	
	Reprogrammings									
	SBIR/STTR Transfer						-3.232			
(U)	Significant Program Changes:									
	Not Applicable.									
	C Performance Metrics									
	(U) Under Development.									
				R-1 Line Iter Page-1 d	m No. 2 of 5				Exhibit R-2 (F	PE 0601103F)
				51 UNCLASS	SIFIED					

	Exi	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 01 B a	ET ACTIVITY asic Research			P 0 11	PE NUMBER AND 0601103F Univ nitiatives	VERSITY Resea	arch	PROJECT NUME 5094 Univers	BER AND TITLE Sity Research	Initiatives
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012 Estimate	FY 2013	Cost to	Total
5094	University Research Initiatives	111 803	119 938	125 949	130 938	135 960	140 507	146 001	Continuing	TRD
5074	Ountity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	
(II)	A Mission Description and Budget Item	Instification			•			1 -		
(U)	superiority; enhances and promotes the edu echnologies; and assists universities in est fundamental component of this program is nterdisciplinary efforts. Note: In FY 2008 Engineering Complex, \$1M for High Tem Research Intiatives. This program is in Bu B. Accomplishments/Planned Program	ucation of U.S. stablishing super- tablishing super- the recognition 8, Congress addo perature Hydrog udget Activity 1, (\$ in Millions)	scientists and e for instrumenta that future tecl ed \$2.4M for B gen and the Spa Basic Science	ngineers in dis tion capabilitie hnologies and t attlespace Red ace Education (, because it fur	ciplines critical es needed to imp technology expl lucing Military Consortium (SE nds scientific stu	to maintaining prove the quali- loitations requi Decision Cycle C), \$2.4M for ady and experim	advancing, a ty of defense-r re highly coord s, \$1M for Fra Secure Grid R nentation.	nd enabling futu elated research dinated and con ank R. Seaver S esearch, and \$8 7 2007	are U.S. defense and education. certed multi- ar cience and M for University <u>FY 2008</u>	e A nd ty <u>FY 2009</u>
(U)	MAJOR THRUST: Promote fundamenta Topics will be selected in scientific reseau nanotechnology, sensor networks, intellig and power conversion, high energy mater	il, multi- and int rch areas related gence informatic rials for propulsi	erdisciplinary s to transformat on fusion, smar on and control	science and eng tional and high t materials and , and enhancing	gineering resear priority techno structures, effic g human perfor	rch projects. logies, such as cient energy mance.	5	54.657	55.682	71.312
(U)	In FY 2007: Funded competitive research technologies usually not achievable throu academic researchers in the early stages of and Engineers (PECASE). Continued fun	h awards at U.S gh typical single of their career th ding of multi-di	universities to investigator a rough the Presi sciplinary prog	o focus on unde wards. Suppor idential Early C grams begun in	erpinning Air Fo ted and recogni Career Award fo prior years.	orce-related zed superior or Scientists				
(U)	In FY 2008: Continue funding competitie Force-related technologies usually not act recognize superior academic researchers is multi-disciplinary programs begun in prior	ve research awa hievable througl in the early stag or years.	rds at U.S. univ n typical single es of their care	versities to focu investigator av er through PEC	us on underpinn wards. Continue CASE. Continue	iing Air e to support and e funding of	1			
(U)	In FY 2009: Continue funding competitiv Force-related technologies usually not acl superior academic research through the P years.	ve research awa hievable througl ECASE. Contin	rds at U.S. univ n typical single ue funding of 1	versities to focu investigator av nulti-disciplina	us on underpinn wards. Support ary programs be	ning Air and recognize egun in prior				
(U) (U)	MAJOR THRUST: Support post-graduat disciplines at U.S. universities. National	te, graduate, and Defense Science	l undergraduate e and Engineer	e education in s ing Graduate P	science and eng Program (NDSE	ineering G) Fellowship	3	36.317	36.325	41.058
Proje	ct 5094			R-1 Line Ite Page-2	m No. 2 of 5				Exhibit R-2a (I	PE 0601103F)

	Exhibit R-2a, RDT&E Project Justi	ification	DA	February	/ 2008
BUD(01 E	GET ACTIVITY asic Research	PE NUMBER AND TITLE 0601103F University Research Initiatives	PROJECT N 5094 Univ	UMBER AND TITLE	h Initiatives
(U)	B. Accomplishments/Planned Program (\$ in Millions) are awarded to train U.S citizens in science and engineering disciplines of military in tri-Service and Office of the Director of Defense Research and Engineering competit	nportance under a joint	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Awarded highly competitive NDSEG fellowships. Supported competities undergraduate research experiences including those established under the Awards to Undergraduate Research Education program. Continued to fund for awards made un Defense programs.	ive awards for graduate and Stimulate and Support der prior year Department of			
(U)	In FY 2008: Continue to award highly competitive NDSEG fellowships. Continue to for graduate and undergraduate research experiences including those established under Support Undergraduate Research Education program. Continue funding for awards repeatment of Defense programs.	o support competitive awards er the Awards to Stimulate and nade under prior year			
(U)	In FY 2009: Continue to award highly competitive NDSEG fellowships. Continue to for graduate and undergraduate research experiences including those established under Support Undergraduate Research Education program. Continue funding for awards repeatment of Defense programs.	o support competitive awards er the Awards to Stimulate and nade under prior year			
(U) (U)	MAJOR THRUST: Enhance the scientific and engineering research through advance	ed education infrastructure and	13,180	11.636	13,579
(U)	instrumentation at U.S. universities. In FY 2007: Conducted the competition for U.S. universities to acquire state-of-the- instrumentation and infrastructure to enhance research and educational capabilities un Research Instrumentation Program	art, high technology nder the Defense University	101100		
(U)	In FY 2008: Continue to conduct the competition for U.S. universities to acquire star instrumentation and infrastructure to enhance research and educational capabilities un Research Instrumentation Program.	te-of-the-art, high technology nder the Defense University			
(U)	In FY 2009: Continue to conduct the competition for U.S. universities to acquire stati instrumentation and infrastructure to enhance research and educational capabilities un Research Instrumentation Program.	te-of-the-art, high technology nder the Defense University			
(U)					
(U) (U) (U) (U)	CONGRESSIONAL ADD: High Assurance Software Engineering. In FY 2007: Conducted research on the security issues in information technology are In FY 2008: Not Applicable. In FY 2009: Not Applicable.	chitectures and components.	1.743	0.000	0.000
Du	R-1 Line I	tem No. 2			
Pro	ect 5094 Page-	3 or 5		Exnidit R-2a	(PE 0601103F)

	Exhibit R-2a, RDT&E Project Justifica	ation	DA	TE February	2008
BUD(01 B	SET ACTIVITY PE I asic Research 060 Init	NUMBER AND TITLE 1103F University Research iatives	PROJECT NI 5094 Univ	JMBER AND TITLE ersity Researcl	n Initiatives
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	CONGRESSIONAL ADD: Single Chip Multi-Modal Nansensors.		3.873	0.000	0.000
(U)	In FY 2007: Conducted research to develop single chip sensors for the detection of chem	ical and biological agents.			
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Partnership in Innovative Preparation for Educators and Stud	lents.	1.065	1.589	0.000
(U)	In FY 2007: Conducted multi-disciplinary research associated with information network	for educators and students.			
(U)	In FY 2008: Continue to conduct multi-disciplinary research associated with information students.	network for educatiors and			
(U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: High Temperature Hydrogen Energy Production.		0.968	0.993	0.000
(U)	In FY 2007: Conducted research to develop methods for hydrogen production.				
(U)	In FY 2008: Continue to conduct research to develop methods for hydrogen production.				
(U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Battle Space Reducing Military Decision Cycle		0.000	2.385	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Develop decision making tool that can result in rapid and effective analyses	of battlefield situational			
	elements and recommendation for response.				
(U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Frank R. Seaver Science and Engineering Complex		0.000	0.993	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Support the Frank R. Seaver Science and Engineering Complex in conducting and engineering disciplines.	ng basic research in science			
(U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Secure Grid Research		0.000	2.385	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct research on the security issues in information technology architect	ares and components.			
(U)	In FY 2009: Not Applicable.	Ĩ			
(U)	CONGRESSIONAL ADD: University Research Initiatives		0.000	7.950	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct university research and support post-graduate, and undergraduate e	ducation in science and	0.000	0.000	0.000
	engineering disciplines.				
Bro	R-1 Line Item I	No. 2		Eyhihit D. Oo	(DE 0601102E)
FIU	5/	5			

	Exhibit R-	2a, RDT&E	Project Ju	stification			DATE	February	/ 2008
BUDGET ACTIVITY 01 Basic Research				PE NUMBER A 0601103F U Initiatives	ND TITLE	earch	PROJECT NUM 5094 Univer	IBER AND TITLE sity Researc	h Initiatives
 (U) <u>B. Accomplishments/Planned I</u> (U) In FY 2009: Not Applicable (U) Total Cost 	Program (\$ in Mil	llions)				<u>F</u> 1	<u>Y 2007</u> 11.803	<u>FY 2008</u> 119.938	<u>FY 2009</u> 125.949
 (U) <u>C. Other Program Funding Sur</u> (U) Related Activities: (U) PE 0601102F, Defense Research Sciences. This project has been coordinated 	<u>mmary (\$ in Millio</u> <u>FY 2007</u> <u>Actual</u> I through the Relia	ons) FY 2008 Estimate nce 21 process to	<u>FY 2009</u> <u>Estimate</u> o harmonize eff	<u>FY 2010</u> <u>Estimate</u> Forts and eliminat	<u>FY 2011</u> <u>Estimate</u> te duplication.	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>	Total Cost
(U) D. Acquisition Strategy Not Applicable.									
Project 5094			R-1 Lin Pa	e Item No. 2 ge-5 of 5 55				Exhibit R-2a	(PE 0601103F)

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

	Exhibit R-2, RDT&E Budget Item Justification									DATE February 2008		
80DGi 01 B a	ET ACTIVITY asic Research			РЕ О(E NUMBER AND	TITLE h Energy Las	er Research	Initiatives				
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010 FY 202		FY 2011 FY 2012		Cost to	Total		
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete			
	Total Program Element (PE) Cost	12.016	12.556	13.425	13.030	13.488	14.621	14.506	Continuing	TBD		
5097	High Energy Laser Research Initiatves	12.016	12.556	13.425	13.030	13.488	14.621	14.506	Continuing	TBD		
(U) <u>2</u> 3 5 1 1 1 1 1 5	A. Mission Description and Budget Item This program funds basic research aimed at systems. The HEL Joint Technology Office echnologies. In addition, funding is spent ools, scholarships, and summer intern emp physics-based models of HEL systems. Thi program, the DoD invests in research direct security needs.	Justification t developing fur e (JTO) sends th on educational loyees in milita s program is in ted toward incre	damental scier nese funds to m grants which ar ry laboratories. Budget Activit easing knowled	ntific knowledg nulti-disciplinar re designed to s . These funds a y 1, Basic Rese ge and underst	te to support fur ry research inst stimulate intere are also used for earch, because anding in those	ture Department titutes (MRIs) f est in HELs. The or modeling and it funds scienti- e fields of scient	nt of Defense (l for projects on l nese educationa d simulation pro- fic study and ex ce and enginee	DoD) high ener laser and beam al grants are use ojects for the re xperimentation. cring related to l	gy laser (HEL) control d for education search of Through this long-term natio	nal		
(U)	<u>B. Program Change Summary (\$ in Mill</u>	lions)										
							<u>FY 2007</u>	<u>FY 2</u>	<u>2008</u>	<u>FY 2009</u>		
(U)	Previous President's Budget						12.356	12	.636	13.735		
(U)	Current PBR/President's Budget						12.016	12	.556	13.425		
(U)	Total Adjustments						-0.340	-0.	.080			
(U)	Congressional Program Reductions											
	Congressional Rescissions							-0.	.080			
	Congressional Increases											
	Reprogrammings						0.040					
	SBIR/STIR Transfer						-0.340					
(U)	Significant Program Changes:											
	Not Applicable.											
	C. Performance Metrics											
	Under Development.											
				R-1 Line Iten	n No. 3							
				Page-1 o	of 5				Exhibit R-2 (F	PE 0601108F)		
				57								

	Ext	nibit R-2a, I	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUD(01 B	BUDGET ACTIVITY 01 Basic Research				E NUMBER AND 601108F Hig Research Initi	DITITLE h Energy Las atives	ser	PROJECT NUMBER AND TITLE 5097 High Energy Laser Research Initiatves		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ in Minons)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5097	High Energy Laser Research Initiatves	12.016	12.556	13.425	13.030	13.488	14.621	14.506	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This program funds basic research aimed a systems. The HEL Joint Technology Offic technologies. In addition, funding is spent tools, scholarships, and summer intern emp physics-based models of HEL systems. Thi program, the DoD invests in research direc security needs.	t developing fu e (JTO) sends t on educational bloyees in milita is program is in ted toward incr	ndamental scie hese funds to r grants which a rry laboratories Budget Activi easing knowled	ntific knowledg nulti-disciplina re designed to s. These funds ty 1, Basic Res dge and underst	ge to support fu ry research inst stimulate intere are also used fo earch, because tanding in those	ture Departme titutes (MRIs) f est in HELs. Th or modeling and it funds scienti e fields of scier	nt of Defense for projects on hese education d simulation p fic study and e nce and engine	(DoD) high ene laser and beam al grants are use rojects for the re experimentation ering related to	rgy laser (HEL) control ed for education esearch of a. Through this long-term natio) nal
(U) (U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Improve the fundame electron, and gas laser technologies. In FY 2007: Completed research projects Conducted fiber laser research focused on fibers. Conducted fundamental research of call for innovative research related to gas, In FY 2008: Conduct fiber laser research multiple fibers. Conduct fundamental rese research on selected topics in gas, free ele In FY 2009: Conduct fiber laser research multiple fibers. Conduct fundamental rese research on selected topics in gas, free ele	(\$ in Millions) ental understand on closed-cycl single aperture on optically-pur free electron, a focused on sing earch on optica ctron, and solid focused on sing earch on optica	ling of high-po e chemical, fre e scaling single nped atomic an ind solid state 1 gle aperture sca lly-pumped ato gle aperture sca lly-pumped ato	wer laser source e electron, and -mode fibers, a ad molecular ga aser topics, awaing of single-ro- pmic and molece hnologies. aling of single-ro- pmic and molece	es, to include s solid state lase nd organization is lasers. Cond arded nine effo mode fibers and ular gas lasers. mode fibers and ular gas lasers.	olid-state, free r initiatives. n of multiple ucted a MRI rts. d combining Initiate d combining Conduct	<u>F</u>)	<u>7.110</u>	<u>FY 2008</u> 7.498	<u>FY 2009</u> 7.993
(U) (U) (U)	MAJOR THRUST: Improve the fundame power laser applications. Conduct research technology. in FY 2007: Improved negative thermal e measured thermal and strain responses of computational atmospheric propagation efforts.	ental understand ch in atmospher expansion optic these coatings. ffects, advanced	ling of beam co ic characteriza al coating mate Completed res I wavefront ser	ontrol technolog tion and beam of trials to match a search on impro- nsing, and therm	gies as they rela control compor zero expansion oving theoretica nal blooming e	ate to high nent substrates and al and ffects.		2.493	2.559	2.882
Proj	ect 5097			R-1 Line Iter Page-2	m No. 3 of 5				Exhibit R-2a (F	PE 0601108F)

	D/	DATE February 2008				
BUDGET ACTIVITY 01 Basic Research		PE NUMBER AND TITLE 0601108F High Energy Laser Research Initiatives	PROJECT N 5097 High Initiatves	NUMBER AND TITLE gh Energy Laser Research ss		
(U) <u>B. Accomplishments/Planne</u> Conducted an MRI call for in awarded four efforts.	the second secon	rol technology and techniques,	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2008: Complete negati control technologies and	we thermal expansion research. Initiate research niques.	on selected topics for improved beam				
(U) In FY 2009: Conduct researc(U)	h on selected topics for improved beam control te	echnologies and techniques.				
 (U) MAJOR THRUST: Evaluate (U) In FY 2007: Merged develop Conducted mission-level HEI (U) In FY 2008: Continue to develop 	 MAJOR THRUST: Evaluate high-fidelity engineering models for incorporation into the HEL toolkit. In FY 2007: Merged developed models into a common architecture through verification and validation techniques. Conducted mission-level HEL engagement scenarios and wargame HEL concepts. In FY 2008: Continue to develop models and merge them into a common architecture through verification and 					
 validation techniques. Condu (U) In FY 2009: Continue to devo validation techniques. Condu 	ct mission-level HEL engagement scenarios and elop models and merge them into a common arch act mission-level HEL engagement scenarios and	wargame HEL concepts. itecture through verification and wargame HEL concepts.				
 (U) MAJOR THRUST: Fund edu (U) In FY 2007: Provided schola service academies to stimulate stimulate science and math stu- continuing education for profe- 	Icational grants intended to simulate interest in H rships and internships in areas directly supporting e HEL studies among military cadets. Provided s udies, with an emphasis on lasers and optics. Fur essionals in the HEL field.	EL technologies among students. g HEL research. Provided grants to support to K-12 school programs to inded publication of journals and	0.648	0.705	0.750	
(U) In FY 2008: Provide scholars Service Academies to stimula stimulate science and math str continuing education for profe	ships and internships in areas directly supporting at HEL studies among military cadets. Provide s udies, with an emphasis on lasers and optics. Fur	HEL research. Provide grants to support to K-12 school programs to ad publication of journals and				
 (U) In FY 2009: Provide scholars Service Academies to stimula stimulate science and math sti continuing education for profit 	ships and internships in areas directly supporting to the HEL studies among military cadets. Provide s udies, with an emphasis on lasers and optics. Fur essionals in the HEL field	HEL researches. Provide grants to upport to K-12 school programs to d publication of journals and				
(U) Total Cost			12.016	12.556	13.425	
	R-	1 Line Item No. 3				

		Exhibit R-	2a, RDT&E	Project Ju	stification			DAT	February 2008
BUDGET ACTIVITY 01 Basic Research			PE NUMBER A 0601108F H Research Ir	ND TITLE ligh Energy La nitiatives	aser	PROJECT NUMBER AND TITLE 5097 High Energy Laser Research Initiatves			
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u>	ons)						
		<u>FY 2007</u> Actual	<u>FY 2008</u> 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	Complete Total Cost
(U)	PE 0602890F, High Energy								
	Laser Research.								
(U)	PE 0603444F, Maui Space								
	Surveillance System.								
(U)	PE 0603605F, Advanced								
	Weapons Technology.								
(U)	PE 0603924F, High Energy								
	Laser Advanced Technology								
	Program.								
(U)	PE 0602605F, Directed Energy								
	Technology.								
(U)	PE 0602120A, Sensors and								
	Electronic Survivability.								
(U)	PE 0602307A, Advanced								
	Weapons Technology.								
(U)	PE 0602624A, Weapons and								
	Munitions Technology.								
(\mathbf{U})	PE 0603004A, Weapons and								
	Tashualassa								
	DE 0602114N. Dower Projection								
(0)	Applied Passarah								
(II)	Applied Research. DE 0602702E Tractical								
(0)	Technology								
an	PE 0603175C Ballistic Missile								
(0)	Defense Technology								
ДD	PE 0603883C Ballistic Missile								
(0)	Defense Boost Phase Segment								
ധ	PE 0602651M. Joint Non-Lethal								
				R-1 Lir	ne Item No. 3				
Pro	ject 5097			Pa	ge-4 of 5				Exhibit R-2a (PE 0601108F)

Exhibit R-2a, R	DATE Februarv 2008			
BUDGET ACTIVITY 01 Basic Research	PE NUMBER AND TITLE 0601108F High Energy Laser Research Initiatives	PROJECT NUMBER AND TITLE 5097 High Energy Laser Research Initiatves		
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Weapons Applied Research. (U) PE 0603651M, Joint Non-Lethal Weapons Technology Development. (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. 				
Project 5097	R-1 Line Item No. 3 Page-5 of 5 61	Exhibit R-2a (PE 0601108F)		

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PE NUMBER: 0602015F PE TITLE: Medical Development

Exhibit R-2, RDT&E Budget Item Justification								DATE	February	2008
BUD 02 /	GET ACTIVITY Applied Research			PI 0	E NUMBER AND 602015F Mec	TITLE lical Develop	ment			
	Cost (\$ in Millions)	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	Complete	
	Total Program Element (PE) Cost	0.000	4.670	0.000	0.000	0.000	0.000	0.000	0.000	0.000
524	4 Diabetes Research	0.000	4.670	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Note Med Susc (U) (U) (U)	 E: Funds for the FY 2008 Congressionally-d lical Response (Yale New Haven Health Systeptability Gene in the amount of \$1.5 million A. Mission Description and Budget Item Funds for the FY 2008 Congressionally-din Medical Response (Yale New Haven Healt of Autism Susceptability Gene in the amoun Development, for execution. This programe evolutionary and revolutionary technologie B. Program Change Summary (\$ in Mill Previous President's Budget Current PBR/President's Budget 	lirected Tricordo stem) in the amo on, are in the pro a Justification rected Tricorder th System) in th ant of \$1.5 milli- n is in Budget A es. llions)	er Detector in t pount of \$2.0 mi pocess of being n Detector in the e amount of \$2 on, are in the p ctivity 2, Appl	he amount of \$ llion, and Com moved to the D e amount of \$1 .0 million, and rocess of being ied Research, s	1.2 million, Na prehensive Clin efense Health .2 million, Nat Comprehensiv moved to the ince it develop	ational Center f nical Phenotypi Program, from ional Center fo ve Clinical Pher Defense Health s and determine	or Integrated C ing and Genetic PE 0602015F, r Integrated Civ notyping and G Program, from es the technical <u>FY 2007</u> 23.810 0.000	ivilian-Military Mapping for the Medical Develor vilian-Military I enetic Mapping PE 0602015F, feasibility and <u>FY 2</u> 0 4	Domestic Dis he Discovery of poment, for exe Domestic Disas for the Discov Medical military utility 2008 .000 .670	aster of Autism ecution. ster yery of <u>FY 2009</u> 0.000 0.000
(U) (U) (U)	Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer <u>Significant Program Changes:</u> Not Applicable. C. Performance Metrics Under Development.						-23.810	4 -0 4	.670 .030 .700	
				R-1 Line Iter Page-1	m No. 7 of 3				Exhibit R-2 (PE 0602015F)
				63 UNCLASS	SIFIED					

Exhibit R-2a, RDT&E Project Justification									February	2008
BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602015F Medical Development					ment	PROJECT NUM 5244 Diabete	BER AND TITLE es Research			
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5244	Diabetes Research	0.000	4.670	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		
Note: Medio Susce	Note: Funds for the FY 2008 Congressionally-directed Tricorder Detector in the amount of \$1.2 million, National Center for Integrated Civilian-Military Domestic Disaster Medical Response (Yale New Haven Health System) in the amount of \$2.0 million, and Comprehensive Clinical Phenotyping and Genetic Mapping for the Discovery of Autism Susceptability Gene in the amount of \$1.5 million, are in the process of being moved to the Defense Health Program, from PE 0602015F, Medical Development, for execution.									
(U)	A. Mission Description and Budget Item Funds for the FY 2008 Congressionally-dir Medical Response (Yale New Haven Healt of Autism Susceptability Gene in the amou Development, for execution. This program evolutionary and revolutionary technologie	Justification rected Tricorder h System) in th nt of \$1.5 million is in Budget A res.	Detector in the e amount of \$2 on, are in the p ctivity 2, Appl	e amount of \$1 .0 million, and rocess of being ied Research, s	.2 million, Nati Comprehensiv moved to the l ince it develops	ional Center for re Clinical Pher Defense Health s and determine	r Integrated Ci notyping and G Program, from es the technica	vilian-Military Jenetic Mappin n PE 0602015F l feasibility and	Domestic Disa g for the Discov 7, Medical d military utility	ster very 7 of
(U)	B. Accomplishments/Planned Program	(\$ in Millions)					FY	2007	FY 2008	FY 2009
(U)	CONGRESSIONAL ADD: Tricorder De	tector.						0.000	1.192	0.000
(U)	In FY 2007: Not Applicable.									
(U)	In FY 2008: Conduct Congressionally-dir	rected effort for	Tricorder Det	ector.						
(U)	In FY 2009: Not Applicable.									
(U)										
(U)	CONGRESSIONAL ADD: National Cen	ter for Integrate	ed Civilian-Mil	itary Domestic	Disaster Medie	cal Response		0.000	1.988	0.000
	(Yale New Haven Health System).	-		-		-				
(U)	In FY 2007: Not Applicable.									
(U)	In FY 2008: Conduct Congressionally-dia	rected effort for	National Cent	er for Integrate	d Civilian-Mili	tary Domestic				
	Disaster Medical Response (Yale New Ha	wen Health Sys	tem).							
(U)	In FY 2009: Not Applicable.									
(U)										
(U)	CONGRESSIONAL ADD: Comprehensi Susceptability Gene.	ve Clinical Phe	notyping and C	Genetic Mappin	ng for the Disco	overy of Autisn	1	0.000	1.490	0.000
(U)	In FY 2007: Not Applicable.									
(U)	In FY 2008: Conduct Congressionally-dia	rected effort for	Comprehensiv	ve Clinical Pher	notyping and G	enetic				
	Mapping for the Discovery of Autism Sus	ceptability Gen	e.							
(U)	In FY 2009: Not Applicable.									
(U)	Total Cost							0.000	4.670	0.000
				R-1 Lina Har	m No. 7					
Proje	ect 5244			Page-2	of 3				Exhibit R-2a (PE 0602015F)
				64						

Exhibit R	DATE	February 2008						
BUDGET ACTIVITY 02 Applied Research			PE NUMBER A 0602015F M	ND TITLE edical Develo	pment	PROJECT NUMBER AND TITLE 5244 Diabetes Research		
(U) <u>C. Other Program Funding Summary (\$ in Mill</u>	<u>ions)</u>							
<u>FY 2007</u> Actual	<u>FY 2008</u> 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	Cost to Complete <u>Total Cost</u>	
(U) Related Activities: Not Applicable.	Listinade	Diffinate	Estimate	Estimate	Distillate	Estimate	comprete	
(U) <u>D. Acquisition Strategy</u> Not Applicable.								
			tom No. 7					
Project 5244		R-1 Line Pag	e item No. 7 e-3 of 3				Exhibit R-2a (PE 0602015F)	
			65					

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PE NUMBER: 0602102F PE TITLE: Materials

	Exhib	DATE	February	2008						
BUDGE 02 App	BUDGET ACTIVITY 02 Applied Research			PI 0	PE NUMBER AND TITLE 0602102F Materials					
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	151.438	179.516	117.143	127.504	126.999	130.567	126.415	Continuing	TBD
01SP	Space Materials Development	25.728	37.558	29.042	34.161	33.801	32.654	33.337	Continuing	TBD
4347	Materials for Structures, Propulsion, and Subsystems	70.723	73.257	44.313	52.955	54.892	56.284	55.495	Continuing	TBD
4348	Materials for Electronics, Optics, and Survivability	26.687	29.751	21.480	19.990	17.982	20.032	15.807	Continuing	TBD
4349	Materials Technology for Sustainment	21.550	27.642	18.662	17.692	17.590	18.698	18.771	Continuing	TBD
4915	Deployed Air Base Technology	6.750	11.308	3.646	2.706	2.734	2.899	3.005	Continuing	TBD

Note: FY 2008 funding totals do not include \$3.7 million FY 2008 GWOT requirements still pending Congressional consideration.

(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 five projects that develop: (1) the materials and processing technology base for spacecraft and launch systems; (2) structural, propulsion, and sub-systems materials and processes technologies; (3) electronic, optical, and survivability materials and processes technologies; (4) sustainment materials, processes technologies, and advanced non-destructive inspection methodologies; and (5) air base operations technologies including deployable base infrastructure, force protection, and fire fighting capabilities. Note: In FY 2008 Congress added \$1.6 million for Chrome Free Environmentally Friendly Corrosion Protection for Aircraft, \$1.6 million for Free Electron Laser Capabilities for Aerospace Microfabrication, \$4.8 million for Intelligent Carbon nanotube Based Computer Devices for Space Applications, \$1.0 million for Aircraft Active Corrosion Protective Compounds, \$2.8 million for Accelerated Insertion of Advanced Materials and Certification for Military Aircraft Structure Material, \$1.6 million for Blast Resistant Concrete Products, \$1.6 million for Large Area, APVT Materials Development for High Power Devices, \$1.6 million for Plasma-Sphere Array for Flexible Electronics, \$3.0 million for Advanced Carbon Fiber Research and Testing Initiative, \$2.5 million for Institute for Science and Engineering Simulation (ISES) / Aircraft Fatigue Modeling and Simulation, \$1.6 million for Science for Sustainment Initiative to Improve Mission, \$3.2 million for Oregon Nanoscience and Microtechnologies Institute (ONAMI) Safer Nanomaterials and Nanomanufacturing, \$1.6 million for Pennsylvania Nanomaterials Commercialization Center, \$1.6 million for High Temperature Aerogel Materials for Global Strike Vehicles, \$0.8 million for Polymer Nanocomposites for Energy Storage and Pulsed Power, \$1.6 million for Carbon Nano-Materials for Advanced Aerospace Applications, AQW Rice University, \$2.4 million for University of Houston Consortium for Nanomaterials for Aerospace Commerce and Technology (CONTACT), \$1.6 million for Gallium Nitride (GaN) RF Power Technology, \$1.0 million for Life Shield Blast Resistant Panels, \$1.6 million for Advanced Aerospace Carbon Foam Heat Exchangers, \$0.96 million for Advanced Engineered Non-Linear Optical Materials for Critical Wavelengths, \$6.0 million for Air Force Minority Leaders Program, \$1.2 million for Durable Hybrid Coatings for Aircraft Systems, \$1.6 million for Fire and Blast Resistant Materials for Force Protection, \$1.6 million for Nanocomposites for Lightning Protection of Composite Airframe Structures, \$5.0 million for Nanotechnology Research, \$2.9 million for Polymer Stress and Sensor Damage Sensors for Composites, and \$1.0 million for Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction. Congress also reduced Affordable structural and non-structural materials for space by \$1.5 million for program growth. This program is in Budget

Exhibit R-2 (PE 0602102F)

	Exhibit R-2, RDT	Exhibit R-2, RDT&E Budget Item Justification			
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials	-		
	Activity 2, Applied Research, since it develops and determine	ines the technical feasibility and military utility of evolutionary and rev	volutionary technologies.		
(U)	B. Program Change Summary (\$ in Millions)				
		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	Previous President's Budget	153.293	122.794	110.412	
(U)	Current PBR/President's Budget	151.438	179.516	117.143	
(U)	Total Adjustments	-1.855	56.722		
(U)	Congressional Program Reductions		-1.500		
	Congressional Rescissions		-1.138		
	Congressional Increases		58.360		
	Reprogrammings	0.859	1.000		
	SBIR/STTR Transfer	-2.714			
(U)	Significant Program Changes: Not Applicable.				
	C. Performance Metrics				
	Under Development.				
I					
		R-1 Line Item No. 8 Page-2 of 28	Fxhihit F	R-2 (PF 0602102F)	
L		68	EAHORT	(00021021)	

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	cation			DATE	February	2008
BUDGET ACTIVIT	Y search			PE NUMBER AND TITLE 0602102F Materials				PROJECT NUME 01SP Space	BER AND TITLE Materials Dev	/elopment
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total
01SP Space	Materials Development	25.728	37.558	29.042	34.161	33.801	32.654	33.337	Continuing	TBD
Quanti	ty of RDT&E Articles	0	0	0	0	0	0	0		
Note: In FY 200 Development, in	07, Project 01SP, Space Materia order to more effectively mana	ls Development ge and provide	, efforts transfe oversight of the	er from PE 0602 e efforts.	2500F, Multidi	sciplinary Spac	ce Technology,	Project 5025,	Space Materials	8
This projec current and composites Rocket proj high-tempe resistant to systems and	J) <u>A. Mission Description and Budget Item Justification</u> This project develops the materials and processing technology base for spacecraft and launch systems to improve affordability, maintainability, and performance of current and future Air Force space systems. Families of affordable lightweight materials are being developed, including metals, polymers, ceramics, metallic composites, and nonmetallic composites to provide new capabilities for spacecraft, ballistic missile, and propulsion systems to meet the future space requirements. Rocket propulsion materials development in this project supports the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. Advanced high-temperature protection materials are being developed that are affordable, lightweight, dimensionally stable, thermally conductive, and/or ablation and erosion resistant to meet space and ballistic missile requirements. Materials technologies are also being developed to enable surveillance and terrestrial situational awareness systems and subsystems for space and ballistic missile applications.									
 (U) <u>B. Accom</u> (U) MAJOR T rocket pro systems 	plishments/Planned Program THRUST: Develop materials an pulsion systems. Note: In FY 2	(\$ in Millions) d processes to c 2008, efforts we	ramatically im re reduced to f	prove performation prove performation prove performation performance of the performance o	ance, durability high-temperatu	y, and cost of are protection	<u>FY</u> 1	<u>2007</u> 1.160	<u>FY 2008</u> 3.581	<u>FY 2009</u> 3.241
 (U) In FY 200 material cl ducts, valv componen environme solid rocka replaceme subscale c characteris test sub-el (U) In FY 200 characteris valves, sol that can be Construct 	7: Developed new candidate m haracteristics to meet the next leves, solid rocket casings, insulat its in representative rocket engir ent. Demonstrated innovative his et nozzles, exit cones, throats, an ont of materials. Scaled-up testin omponents. Incorporated innov stics required to meet advanced ements, and sub-components fo 8: Optimize candidate material stics to meet the next level of pe lid rocket casings, insulation, an e tested in rocket engine enviror pervasive materials requiremen	aterials and imp evel of performa- tion, and nozzle the environment. tigh-temperature and spacecraft pr ng from coupon rative materials performance and r thrust chambe s and processing erformance goal d nozzle throats ment. Analyze ts to meet advar	roved processi nce goals for h throats. Evalue Analyzed mat metal, ceramic opulsion comp level to more of and concepts o d cost goals. If rs, nozzles, and g techniques to s for high-spee c. Develop pro- e material beha aced performan	ng techniques t iigh-speed turb ated performant terial behavior is c, and composition onents. Valida complex shapes n demonstrator mproved and o d catalysts. ensure more can d turbopump ho- cesses to produ- vior in rocket co- ice and cost goard	to ensure more opump housing ace of subscale in rocket comb te material can ated material m s and sizes. Fa engines. Iden ptimized select onsistent mater ousings and tur ace full scale te combustion env als. Validate at	consistent gs and turbines, test ustion didates for odels for direct bricated tified materials ted materials, tial cbines, ducts, st components vironment. nd demonstrate				
Project 01SP				R-1 Line Iter Page-3 o 69	m No. 8 If 28				Exhibit R-2a (F	PE 0602102F)

	Exhibit R-2a, RDT&E Project Justifi	DA	DATE February 2008		
BUD(02 A	GET ACTIVITY PI opplied Research 0	E NUMBER AND TITLE 602102F Materials	PROJECT N 01SP Spa	UMBER AND TITLE	evelopment
(U)	B. Accomplishments/Planned Program (\$ in Millions) materials, test sub-elements, and sub-components for thrust chambers, nozzles, and cata	llysts.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(0)	turbines, ducts, valves, solid rocket casings, insulation, and nozzle throats and develop databases for design consideration. Optimize processes to produce full scale test comp rocket engine environment. Analyze material behavior in rocket combustion environm on pervasive materials requirements to meet advanced performance and cost goals. Op sub-elements, and sub-components for thrust chambers, nozzles, and catalysts.				
(U)	,				
(U)	MAJOR THRUST: Develop affordable, advanced structural and non-structural materia technologies for Air Force space applications. Note: In FY 2008, efforts were increase protection systems. In FY 2008 Congress reduced this effort by \$1.5 million for progra	lls and processing d for high-temperature m growth	10.586	18.701	14.739
(U)	In FY 2007: Validated initial material design concept of candidate metallic systems for component operation in robust high-temperature, long duration cruise, or access to space research results and developed knowledge base on liquid oxygen compatibility with Na Administration (NASA) and industry. Evaluated large integrated concepts using compenvironments and provided expertise for design and assessment of structural cryogenic high-temperature protection systems for expendable and reusable high-speed vehicle ap with industry. Validated oxidation protection schemes for carbon-carbon materials for applications. Developed multifunctional nano-tailored composite technologies for space evaluated enhancements obtained. Developed wear-resistant materials, lubricants, and System (MEMS) devices for moving mechanical assemblies on spacecraft. Evaluated collected critical data to facilitate materials transition.	thin gage structures for the environments. Analyzed tional Aeronautics and Space osite materials in cryogenic tanks. Demonstrated oplications in collaboration high-speed vehicle e system capabilities and Micro-Electro-Mechanical candidate space materials and			
(U)	In FY 2008: Develop and validate test methodology and evaluation techniques for pro- prediction of thermal protection system applications for selected thin gage metallic mat processing and integration techniques that will provide the capability for fabrication of built-up structures. Explore materials options for high-temperature protection systems high-speed vehicle applications in collaboration with industry. Transition data on oxid carbon-carbon materials. Demonstrate benefits of nano-tailored composite materials for applications. Validate wear-resistant materials, lubricants, and MEMS devices for mov spacecraft against environment specific criteria. Evaluate candidate space materials and facilitate materials transition.	cessing, durability, and life erials. Develop scale-up complex geometries and for expendable and reusable ation protection schemes for r multifunctional space ing mechanical assemblies on d collect critical data to			
(U)	In FY 2009: Optimize initial test methodology and evaluation techniques for processin	g, durability, and life			
Pro	R-1 Line Iter	n No. 8 f 28		Exhibit P. 20	(PE 0602102E)
-10	70	120			

	Exhibit R-2a, RDT&E Project Justific	DA	TE February	2008	
BUD(02 A	GET ACTIVITYPEopplied Research060	NUMBER AND TITLE D2102F Materials	PROJECT N 01SP Spa	UMBER AND TITLE ce Materials De	velopment
(U)	B. Accomplishments/Planned Program (\$ in Millions) prediction of thermal protection system applications for component operation in robust h long-duration cruise, or access to space environments. Continue materials processing de structural integration into sub-scale components for testing in relative environments. De for high-temperature protection systems for expendable and reusable high-speed vehicle with industry. Evaluate candidate space materials and collect critical data to facilitate materials	igh-temperature, velopment and demonstrate velop materials candidates applications in collaboration aterials transition.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop materials and materials processing technologies to enable in affordability of surveillance, tracking, targeting, situational awareness systems, and space communications/computing. Note: Beginning in FY 2008, there in an increased emphase thrust.	mproved performance and e-based is on efforts in this major	3.982	10.507	11.062
(U)	In FY 2007: Initiated development of nano-photonic materials for high performance opto optical communications and system control architectures. Validated processes and devel methodology to enable very long wavelength infrared detection. Developed suitable mat technologies for application in combined optical and radio frequency communication sys research in nano-photonic materials for applications in very high bandwidth communicat communications, and radar.	pelectronic devices for oped process control erials and materials process tem apertures. Initiated ions and modulators, laser			
(U)	In FY 2008: Demonstrate processes and process control methodology to enable very lon detection. Develop materials processing technology for short wavelength detectors that v staring focal plane arrays with more than 4 million pixels (2k x 2k). Develop nano-photo performance optoelectronic devices for optical communications and system control archi materials and materials process technologies for application in combined optical and radii system apertures.	g wavelength infrared will provide capability of onic materials for high tectures. Demonstrate o frequency communication			
(U)	In FY 2009: Continue to demonstrate processes and process control methodology to enai infrared focal plane arrays. Demonstrate processing technology for short wavelength infi- hybridization and characterization of 2k x 2k format focal plane array. Demonstrate nane high performance optoelectronic devices for optical communications and system control suitable materials and materials process technologies for application in combined optical communication system apertures.	ble very long wavelength rared detectors by p-photonic materials for architectures. Transition and radio frequency			
(U) (U) (U) (U)	CONGRESSIONAL ADD: Intelligent Carbon Nanotube Based Computer Devices for S In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Intelligent Carbon Nanotube B	pace Applications. ased Computer Devices for	0.000	4.769	0.000
Pro	R-1 Line Item ect 01SP Page-5 of 2 71	No. 8 28		Exhibit R-2a	(PE 0602102F)

		Exhibit R-	2a, RDT&E	Project Ju	stification			DATE	February	2008	
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER AND TITLE 0602102F Materials			PROJECT NUMBER AND TITLE 01SP Space Materials Development			
(U) (U)	B. Accomplishments/Planned Pr Space Applications. In FY 2009: Not Applicable.	<u>rogram (\$ in Mil</u>	llions)				<u>FY</u>	2007	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	Total Cost						2	5.728	37.558	29.042	
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons)</u>								
(U) (U)	Related Activities: This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	<u>FY 2007</u> <u>Actual</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>	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>	
	D. Acquisition Strategy Not applicable.										
Pro	oject 01SP			R-1 Lir Paç	ne Item No. 8 ge-6 of 28 72				Exhibit R-2a	(PE 0602102F)	

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUD(02 A	GET ACTIVITY pplied Research			P 0	PE NUMBER AND TITLE 0602102F Materials			PROJECT NUMBER AND TITLE 4347 Materials for Structures, Propulsion, and Subsystems		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4347	7 Materials for Structures, Propulsion, and Subsystems	70.723	73.257	44.313	52.955	54.892	56.284	55.495	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	future Air Force systems. A family of affo composites to provide upgraded capabilitie turbine engine materials that will enable en developed that are affordable, lightweight, requirements. Alternative or replacement n materials, paints, coatings, and other perva missiles. Develops novel materials for elect protection. Concurrently develops advance	scessing technological signal designs to agine designs to dimensionally signaterials are be sive nonstructure ctromagnetic in ed processing m	and the state of t	being develop and propulsion bine engine thr ly conductive, a to maintain the chnologies are matter for elec le adaptive pro	sues to improve bed, including n n systems to me ust-to-weight ra and/or ablation performance o being develope ctromagnetic pu bocessing of aero	e anordability, f netals, polymer eet the future sy atio. Advanced and erosion res of aging operation of for propulsion ilse (EMP), hig space materials	s, ceramics, m rstem requirem l high tempera sistant to meet onal systems. n and subsyste h power micro s.	7, and performa- etallic composi- ture protection r aerospace and r Friction and we ems on aircraft, wave (HPM), a	tes, and nonmet high-temperat materials are be nissile ear-resistant spacecraft, and nd lightning str	ind tallic ure bing rike
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop ceramics an and supportability improvements in advar In FY 2007: Demonstrated advanced cera engine service life conditions. Incorporat prediction model to address time depende severe environment durability of advanced testing.	(\$ in Millions) d ceramic matri- need propulsion amic composite ed environment ent degradation a d ceramic comp	ax composite te systems and h performance to al degradation associated with posite systems	chnologies for igh temperature hrough testing analysis into th environmenta with advanced	revolutionary p e aerospace stru under real and s ne ceramic com l exposure. Des interfaces via n	performance actures. simulated posite life monstrated the nechanical	EY	<u>7 2007</u> 3.714	<u>FY 2008</u> 3.171	<u>FY 2009</u> 2.389
(U) (U)	In FY 2008: Demonstrate advanced cerar service life conditions. Demonstrate envi model. Validate the severe environment of via mechanical testing. In FY 2009: Validate advanced ceramic of service life conditions. Validate the life p environmental exposure. Validate the sev advanced interfaces via mechanical testim	mic composite p ronmental degra durability of adv composite perfo prediction mode vere environmer g.	performance the adation analysi vanced ceramic rmance throug l to address tim at durability of	rough testing u s in the cerami c composite sys h testing under he dependent de advanced ceran	nder real and si c composite life stems with adva real and simula egradation asso mic composite s	mulated engine e prediction unced interfaces ated engine ciated with systems with	8			
(U)	·····	0								
Proj	ect 4347			R-1 Line Ite Page-7 d	m No. 8 of 28				Exhibit R-2a (PE 0602102F)

	Exhibit R-2a, RDT&E Proje	D.	ATE February	/ 2008	
BUDGI 02 A p	ET ACTIVITY oplied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT N 4347 Mate Propulsio	NUMBER AND TITLE terials for Structures, on, and Subsystems	
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) MAJOR THRUST/CONGRESSIONAL ADD: Develop enabling polymer	ic materials for diverse aerospace	<u>FY 2007</u> 11.017	<u>FY 2008</u> 6.324	<u>FY 2009</u> 13.320
	applications including enhanced aircraft canopies, electromagnetic hardenin platforms. Develop nanoscale architectures to address electromagnetic app increase in funding is due to greater emphasis on metamaterials. This effor \$5.7 million in FY 2007 (\$2.3 million for ONAMI Safer Nanomaterials and Consortium for Nanomaterials for Aerospace Commerce and Technology (Materials Development for Force Protection, and \$1.0 million for Enabling				
A D	Three-Dimensional (3D) Microdevice Construction).				
(U)	In FY 2007: Developed second-generation TPA materials for night vision. Demonstrated optical limiting with improvements in nonlinear optical prop	goggle and optical limiting applications. erties using photonic crystals.			
	Demonstrated improved life nanostructured aircraft tires. Demonstrated are				
	rheology-modifying additives for structural component manufacture via res	sin transfer molding processes.			
	adaptive (shape memory and actuator) materials based on polymer nanocor				
	wings, fins, antennas, and mirrors. Demonstrated polymer proton exchange				
	applications. Demonstrated polymer photovoltaic materials for high efficie				
(U)	In FY 2008: Deliver second-generation TPA materials for night vision gog	gele evaluation. Transition photonic			
(-)	crystals for super prism applications. Transition aromatic hyperbranched p	olymers for structural component			
	manufacture via resin transfer molding processes. Develop organic-inorgan	nic metamaterials for Air Force			
	electromagnetic and photonic applications for reduced aperture size, confor	rmal radar, and antenna systems.			
	Transition organic-inorganic nanostructured materials for lightning strike re-	esistant refueling boom. Develop			
	electromagnetic interference (EMI) and high power microwave (HPM) shie	elding for electronics hardening. Develop			
	adaptive (shape memory and actuator) materials based on polymer nanocor- wings, fins, antennas, and mirrors. Develop lightweight, low-cost photovol applications.	nposites for adaptive aircraft structures, ltaics for uninhabited air vehicle			
(U)	In FY 2009: Develop organic-inorganic metamaterials for Air Force electro	omagnetic and photonic applications for			
	reduced aperture size, conformal radar, and antenna systems. Develop EM	I and HPM shielding for electronics			
	hardening. Investigate and develop lightweight, conformal metamaterials w	with properties that will enable compact			
	sensor applications including: conformal array antennas, low EMI electronic complex media. Evaluate the properties of these materials and determine p	ics, and optical elements based upon performance enhancement of fixed			
		R-1 Line Item No. 8			
Proje	ect 4347	Page-8 of 28		Exhibit R-2a	(PE 0602102F)

	Exhibit R-2a, RDT&E Project	DA	February	/ 2008	
BUDG 02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT N 4347 Mate Propulsio	UMBER AND TITLE erials for Struct n, and Subsys	tems
(U)	B. Accomplishments/Planned Program (\$ in Millions) frequency metamaterial optical elements. Assess the viability of obtaining me the demonstration of highly integrated subsystems based on radio frequency ir small, highly directional antenna element device drivers.	tamaterial properties consistent with tegrated circuit applications to enable	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable lightweigh prediction technologies, higher temperature intermetallic alloys, and metals pre enhanced performance, lower acquisition costs, increased durability, and impre systems. Note: This effort includes Congressional Add funding of \$4.3 million Domestic Titanium Powder Manufacturing Initiative and \$3.3 million for Adv Technologies).	nt metallic materials, behavior and life occessing technology to enable oved reliability for Air Force weapon on in FY 2007 (\$1.0 million for anced Aerospace Manufacturing	20.805	15.639	11.035
(U)	In FY 2007: Developed materials-damage predictive approaches for engine he capability. Explored advanced metallic materials for enhanced performance premphasis on higher temperature capability. Developed computational method processing to reduce costs to accelerate insertion of advanced metals into Air I processes and protocols for unitized manufacturing of aerospace components.	ealth determination and life extension ropulsion for air platforms with an s supporting development and Force systems. Demonstrated			
(U)	In FY 2008: Develop materials-damage predictive approaches for engine heal capability. Develop advanced metallic materials for enhanced performance pr emphasis on higher temperature capability. Validate computational methods s to reduce costs to accelerate insertion of advanced metals into Air Force system	th determination and life extension opulsion for air platforms with an upporting development and processing ns.			
(U)	In FY 2009: Validate materials-damage predictive approaches for engine heal capability. Develop and validate advanced metallic materials for enhanced per with an emphasis on higher temperature capability. Transition computational processing to reduce costs to accelerate insertion of advanced metals into Air J	th determination and life extension rformance propulsion for air platforms methods supporting development and Force systems.			
(U)	1				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop affordable, advanced materials and technologies for Air Force systems applications including lightw subcomponents and other structures requiring thermal and/or structural manag Note: This effort includes Congressional Add funding of \$4.0 million in FY 2 Modulus PAN Carbon Fiber Qualification Initiative, \$1.0 million for High Ten Global Strike Vehicles, and \$1.0 million for Hybrid Materials Integration).	organic matrix composite structural reight structures for aerospace ement for environmental control. 007 (\$2.0 million for Domestic High mperature Aerogel Materials for	13.386	8.715	7.943
(U)	In FY 2007: Demonstrated tools and methodologies required for life prediction	n of materials in high temperature			
Proj	ect 4347	1 Line Item No. 8 Page-9 of 28		Exhibit R-2a	(PE 0602102F)

	Exhibit R-2a, RDT&E Project Justification	February	ruary 2008	
BUD(02 A	GET ACTIVITY PE NUMBER AND TITLI Applied Research 0602102F Materials	E PROJECT NU s 4347 Mater Propulsion	MBER AND TITLE rials for Struct n, and Subsyst	ures, tems
(U)	B. Accomplishments/Planned Program (\$ in Millions) turbine engine and airframe structures environments. Demonstrated high temperature organic matrix comp onto relevant DoD platforms. Initiated new material development and affordable processing for space and high-speed vehicle applications. Developed new materials and processes for nanotailored composites with multifunctional capabilities. Continued nanomaterial modeling and technology efforts. Developed and demonstrated advanced material concepts and processes for thermal management applications.	<u>FY 2007</u> osites	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Continue demonstration of life prediction tools for engine and airframe applications. Transiti- temperature organic matrix composites. Downselect and optimize most promising new material systems for and high speed vehicle applications. Demonstrate the multifunctional payoffs of nanotailored composite m for aerospace platform applications. Develop and demonstrate nanomaterials modeling and technology wit emphasis on accelerating the insertion and transition of this class of materials. Validate advanced composite material concepts and processes for specific weapon system needs.	on high r space aterials h an te		
(U)	In FY 2009: Validate benefits of life prediction tools for engine and airframe applications. Demonstrate in performance of new material systems for space and high-speed vehicle applications. Integrate the develope into commercial and industry tools. Develop advanced material concepts and processes to address thermal management applications for weapon and air vehicle platforms.	nproved ed models		
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop nonstructural materials for fluids, lubricants, aircr and corrosion resistant coatings, and specialty treatments to improve system performance and reduce life cy Note: This effort includes Congressional Add funding of \$7.2 million in FY 2007 (\$1.3 million for Durable Coatings for Aircraft Systems, \$1.0 million for Chrome Free Environmentally Friendly Corrosion Protection Aircraft, \$1.0 million for Secure Coating Systems Technology, \$1.0 million for Integral Fuel Tank Protecti Coating System, and \$2.9 million for Advanced Coating Technologies for JSF and F-22 Survivability).	aft topcoat 15.440 vcle costs. e Hybrid on for ve	6.717	4.355
(U) (U)	In FY 2007: Demonstrated candidate gap treatment materials on air vehicles. Completed validation of the analytical models that will be used to predict the optical properties of specialty coatings based on measured Demonstrated and validated the non-chromate surface treatments for aircraft corrosion protection systems. Formulated chrome-free primer for corrosion protection systems with a 30-year life expectancy. Validated multifunctional coatings on engineering components. Downselected surface treatment candidates for furthed development for friction, stiction, and wear control in micro devices. In FY 2008: Transition candidate gap treatment materials on low observable air vehicles. Demonstrate the analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on measured analytical models that will be used to predict the optical properties of specialty coatings based on the special properties of sp	advanced data. er data.		
	Transition the non-chromate surface treatments for aircraft corrosion protection systems. Validate chrome- R-1 Line Item No. 8	free		/===
Pro	Ject 4347 Page-10 of 28		Exhidit R-2a	(PE 0602102F)

	Exhibit R-2a, RDT&E Project Justifi	DA	TE February	2008	
BUD(02 A	JET ACTIVITY PI pplied Research 0	E NUMBER AND TITLE 602102F Materials	PROJECT N 4347 Mate Propulsio	UMBER AND TITLE rials for Struct n, and Subsyst	ures, ems
(U)	B. Accomplishments/Planned Program (\$ in Millions) primer for corrosion protection systems with a 30-year life expectancy. Demonstrate in multifunctional coatings on engineering components. Develop and optimize surface tra- friction, stiction, and wear control in micro devices.	mproved low friction wear eatment candidates for	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Integrate the analytical models into the coatings development applications primer for corrosion protection systems with a 30-year life expectancy. Continue to de friction wear multifunctional coatings on engineering components. Demonstrate surface friction, stiction, and wear control in micro devices.	s. Demonstrate chrome-free monstrate improved low ce treatment candidates for			
(U) (U)	MAJOR THRUST: Develop nanomaterials science and technology in the areas of nano- nano-reactive materials, additives, coated powders and laminates for munitions and pro- higher lethality. Note: In FY 2008, this major thrust pulls together existing technologi Research Laboratory to create an integrated nanoenergetics effort.	oenergetics to provide opulsion with reduced size and es from across the Air Force	0.000	6.062	5.271
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Investigate large-scale synthesis and characterization of energetic nanoma triggerable, nanoscale energetic materials for enhanced energy release munitions and ac design unconventional nanomaterial behavior with regard to energy release via robust r Investigate the transport and compartmentalization of nanoparticles within the environr microstructural characterization tools to provide robust processing-performance correla systems. Investigate multi-component, structured nanoparticle catalyses as controlled r stability and storage as well as providing enhanced ignition for high efficiency air-brea	aterials to provide stable, ccess to space. Discover and modeling and simulation. ment. Develop ations of nanoenergetic release agents for enhancing thing propulsion.			
(U)	In FY 2009: Develop large-scale synthesis and characterization of energetic nanomater triggerable, nanoscale energetic materials for enhanced energy release munitions, high propulsion, and access to space. Establish modeling and simulation tools to support na Analyze the transport and compartmentalization of nanoparticles being investigated as potential environmental impact. Develop microstructural characterization tools to prov processing-performance correlations of nanoenergetic systems. Investigate multi-comp catalyses as controlled release agents for enhancing stability and storage as well as pro-	rials to provide stable, efficiency air-breathing noenergetics development. nanoenergetics to evaluate vide robust ponent, structured nanoparticle viding enhanced ignition.			
(U) (U) (U) (U)	CONGRESSIONAL ADD: Air Force Minority Leaders Program. In FY 2007: Conducted Congressionally-directed effort for Air Force Minority Leader In FY 2008: Conduct Congressionally-directed effort for Air Force Minority Leaders I	· Program. Program.	5.383	5.962	0.000
Pro	ect 4347 R-1 Line Iter Page-11	m No. 8 of 28		Exhibit R-2a	(PE 0602102F)

	Exhibit R-2a, RDT&E Project Just	DA	DATE February 2008		
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT N 4347 Mate Propulsio	UMBER AND TITLE erials for Struct on, and Subsys	tures, tems
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Not Applicable.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Pennsylvania Nanomaterials Commercialization Center In FY 2007: Conducted Congressionally-directed effort for NanoMaterials Comme In FY 2008: Conduct Congressionally-directed effort for Pennsylvania Nanomateri In FY 2009: Not Applicable.	r. rcialization Center. als Commercialization Center.	0.978	1.589	0.000
(U) (U) (U) (U)	CONGRESSIONAL ADD: Carbon Nano-Materials for Advanced Aerospace Apple In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Carbon Nano-Materials for Applications, AOW Rice University.	ications, AQW Rice University. or Advanced Aerospace	0.000	1.589	0.000
(U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Nanocomposites for Lightning Protection of Composite In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Nanocomposites for Light Airframe Structures	e Airframe Structures. tning Protection of Composite	0.000	1.589	0.000
(U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Nanotechnology Research. In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Nanotechnology Research In FY 2009: Not Applicable	1.	0.000	4.970	0.000
(U) (U) (U) (U) (U) (U)	CONGRESSIONAL ADD: ONAMI Safer Nanomaterials and Nanomanufacturing. In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for ONAMI Safer Nanomater In FY 2009: Not Applicable.	rials and Nanomanufacturing.	0.000	3.182	0.000
(U) (U)	CONGRESSIONAL ADD: University of Houston Consortium for Nanomaterials f Technology (CONTACT).	or Aerospace Commerce and	0.000	2.385	0.000
Pro	ect 4347 R-1 Line Page-	Item No. 8 12 of 28 78		Exhibit R-2a	(PE 0602102F)

Exhibit R-2a, RDT&E P	DA	TE February	/ 2008	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT N 4347 Mate Propulsio	UMBER AND TITLE rials for Struct n, and Subsyst	ures, tems
 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for University (U) In FY 2009: Not Applicable. 	of Houston CONTACT.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) (U) CONGRESSIONAL ADD: Innovative Polymeric Materials for Three (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Innovative Construction. (U) In FY 2009: Not Applicable. 	e-Dimensional (3-D) Microdevice Construction. Polymeric Materials for 3-D Microdevice	0.000	0.993	0.000
 (U) (U) CONGRESSIONAL ADD: High Temperature Aerogel Materials for (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for High Temp Vehicles. (U) In FY 2009: Not Applicable. 	Global Strike Vehicles. Perature Aerogel Materials for Global Strike	0.000	1.589	0.000
 (U) (U) CONGRESSIONAL ADD: Durable Hybrid Coatings for Aircraft Sy. (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Durable Hy (U) In FY 2009: Not Applicable. (U) 	stems. /brid Coatings for Aircraft Systems.	0.000	1.192	0.000
 (U) CONGRESSIONAL ADD: Chrome Free Environmentally Friendly ((U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Chrome Free Protection for Aircraft. (U) In FY 2009: Not Applicable. (U) 	Corrosion Protection for Aircraft. ee Environmentally Friendly Corrosion	0.000	1.589	0.000
(U) Total Cost		70.723	73.257	44.313
Project 4347	R-1 Line Item No. 8 Page-13 of 28		Exhibit R-2a	(PE 0602102F)

Exhibit R-2a, RDT&E Project Justification Fe									
BUDGET ACTIVITY 02 Applied Research	UDGET ACTIVITY 2 Applied Research			PE NUMBER AND TITLE 0602102F Materials			PROJECT NUMBER AND TITLE 4347 Materials for Structures, Propulsion, and Subsystems		
(U) <u>C. Other Program Funding Summ</u>	<u>ary (\$ in Millic</u>	<u>ons)</u>							
	<u>FY 2007</u> Actual	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete <u>Total Cost</u>	
 (U) Related Activities: (U) PE 0603112F, Advanced Materials for Weapon Systems. (U) 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 harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. 									
Project 4347			R-1 Lin Page	e Item No. 8 e-14 of 28 80				Exhibit R-2a (PE 0602102F)	

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 02 A	ET ACTIVITY oplied Research			F	PE NUMBER AND D602102F Mat	O TITLE erials		PROJECT NUMBER AND TITLE 4348 Materials for Electronics, Optics, and Survivability		
	Cost (\$ in Millions)	FY 2007 Actual	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	26.687	29.751	21.480	19.990	17.982	20.032	15.807	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project develops materials technologic nicrowave, and infrared detection and coun aircrews, sensors, and aircraft from laser ar o enable surveillance and situational aware operating temperatures), greater sensitivity respond to emerging and agile threat wavel B. Accomplishments/Planned Program	es for surveillan ntermeasures de nd high-power r eness with faste , and extended engths without (\$ in Millions)	ce and situatio evices used for nicrowave dire r operating spe dynamic range impairing miss	nal awareness targeting, elec ected energy th eeds, greater tu . New materia sion effectiven	systems and sul etronic warfare, reats are also de nability, higher ils are being dev ess.	bsystems for ai and active airc eveloped. Elec power output, veloped to coun	rcraft and miss raft protection tronic and opti improved ther ter the most p	sile applications Materials for p ical materials ar mal management rominent laser t 2 2007	s, including sens protection of e being develop nt (including high hreats and to <u>FY 2008</u>	sor, bed gher <u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop, evaluate, ar technologies to enable improved performa tracking, targeting, and situational awaren In FY 2007: Validated optical, structural, ability to provide unique IR detection prop of single element multispectral IR materia potential for three-dimensional material gr Validated promising materials growth tech	ad mature infrar ance, affordabili ess systems. and electronic perties of intere als with respons rowth to exploit hnologies for na	ed (IR) detectory ty, and operation properties of in st to the Air For es to more than a unique detect uno-scale IR de	or materials and onal capability nnovative IR morce. Character two discreters ion properties of tection materia	d materials proc y of Air Force su naterials to deter rized and evalua wavelengths. Ir of complex IR 1 als.	cessing urveillance, rmine their ated the utility westigated the materials.		1.184	1.720	1.917
(U) (U)	In FY 2008: Explore and validate suitable appropriateness for Air Force IR detection responses to more than two discrete wavel three-dimensional material growth to expl promising materials growth technologies f devices fabricated for high power applicat Improve materials matching between devi increased power density to enable power of In FY 2009: Develop materials and transi- newly emerging material concepts. Valid two discrete wavelengths. Develop candid	e materials and a applications. I lengths. Assess oit unique detect for nano-scale I tions. Investiga ce and substrated dense devices. Ition strategies f ate and optimiz date materials for	structures for i Design and der feasibility of i ction propertie R detection ma te materials to es to enable hig for innovative l e IR materials or three-dimen	nnovative IR r monstrate IR m further research s of complex II aterials. Devel enable develog gher power effi IR materials w systems capab sional growth	naterials in orden naterials system h and utility of R materials. De lop epitaxial ma pment of design iciency, better r hile continuing le of responses to exploit uniqu	er to assess s capable of evelop terials and a capabilities. eliability, and to exploit to more than be detection				
Proje	ct 4348			R-1 Line Ite Page-15	em No. 8 of 28				Exhibit R-2a (I	PE 0602102F)
				81						

	Exhibit R-2a, RDT&E Project Justific	DA	TE February	/ 2008	
BUDO 02 A	PE ACTIVITY PE	NUMBER AND TITLE 602102F Materials	PROJECT N 4348 Mate Optics, an	IUMBER AND TITLE erials for Electronics, nd Survivability	
(U)	B. Accomplishments/Planned Program (\$ in Millions) properties of complex IR materials. Develop promising materials growth technologies f materials. Demonstrate epitaxial materials device and substrate improvements. Develo leveraging new materials and substrates. Develop tools and methodologies that address power dense devices.	for nano-scale IR detection p design capability, the physics of failure for	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	MAJOR THRUST: Develop and demonstrate enabling materials technologies to enhan and mission effectiveness of aircrews, sensors, viewing systems, and related assets. In FY 2007: Incorporated optimized nonlinear optical limiter materials for damage prot	ce the safety, survivability, tection of eyes and sensor	7.613	9.721	9.522
(U)	systems. Optimized photorefractive materials properties for Air Force passive protection switchable filter technology into device concepts for eye and sensor system protection. In FY 2008: Demonstrate optimized nonlinear optical limiter materials for damage prot systems. Validate photorefractive materials properties for Air Force passive protection				
(U)	devices using switchable filter technology into eye and sensor system protection concept In FY 2009: Develop nonlinear optical limiter materials into device concepts for damage sensor systems. Develop photorefractive materials into device concepts for Air Force p	ts. ge protection of eyes and assive protection			
۵D	applications. Demonstrate devices using switchable filter technology into eye and sense	or system protection concepts.			
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate materials and power generation, power control, and microwave components to provide improved perferoperational capability for Air Force surveillance, tracking, targeting, situational awarene weapon systems. Note: This effort includes Congressional Add funding of \$2.4 million for Power Electronics Reliability and \$1.0 million for Advanced Materials Deposition for	process technologies for ormance, affordability, and ess, and lethal and non-lethal n in FY 2007 (\$1.4 million or Semiconductor).	9.767	8.231	8.340
(U)	In FY 2007: Demonstrated capabilities of advanced materials and materials process tec lethal and non-lethal directed energy weapons in fighter-sized aircraft. Demonstrated so materials processes to provide presently unattainable performance for power control sys electronic countermeasures. Demonstrated capabilities of advanced materials and materials provide improvements and additional capabilities relative to baseline materials/processes ultra-high-power aircraft electrical generators enabling airborne lethal and non-lethal dir fighter-sized aircraft. Validated and demonstrated selected materials and materials proc Terahertz components, supporting high speed communications and advanced sensors.	hnologies to enable airborne cale-up of materials and stems, advanced radar, and rials process technologies to es for ultra-lightweight, rected energy weapons in sess technologies for use in			
(U)	In FY 2008: Explore materials impact on device reliability for power control systems, a	advanced radar, and electronic			
Proj	ect 4348 R-1 Line Item Page-16 o	n No. 8 f 28		Exhibit R-2a	(PE 0602102F)

Exhibit R-2a, R	DT&E Project Justification	DATE February 2008				
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT N 4348 Mate Optics, an	UMBER AND TITLE rials for Electro od Survivability	onics,		
(U) B. Accomplishments/Planned Program (\$ in Millions) countermeasures application. Demonstrate the capabilities investigate the reliability of materials as applied to ultra-lig enabling airborne lethal and non-lethal directed energy wea of candidate materials for use in Terahertz components, sug sensors.	s of advanced materials process technologies as well as ghtweight, ultra-high-power aircraft electrical generators apons in fighter-sized aircraft. Demonstrate performance pporting high speed communications and advanced	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) In FY 2009: Optimize materials properties for enhanced d ultra-lightweight, ultra-high-power aircraft electrical gener directed energy weapons in fighter-sized aircraft. Demons Terahertz components, supporting high speed communicat	evice reliability. Assess the reliability of materials for ator applications, enabling airborne lethal and non-lethal trate performance of candidate materials for use in ions and advanced sensors.					
 (U) (U) MAJOR THRUST: Develop enabling and foundational bio tagging, tracking, and identification of targets, and bio-inter dominance. Note: In FY 2008, this major thrust pulls toge Research Laboratory to create an integrated biotechnologie 	otechnologies for the areas of guidance and control, rapid egrated electronics and sensing for continued Air Force ether existing technologies from across the Air Force	0.000	1.972	1.701		
 (U) In FY 2007: Not Applicable. (U) In FY 2008: Investigate use of biological/nanomaterial-ba CBRNE targets at a distance using hybrid constructs. Asse counterproliferation operations. Neutralize biological and properties of the taggant nanoparticles. Develop active and materials. 	sed taggants for the detection and identification of ess effectiveness of CBRNE destruction using taggants in chemical agents with the inherent and supplementary d passive polymer encapsulation technologies for taggant					
 (U) In FY 2009: Develop new biological/nanomaterial hybrids Analyze efficacy data of using taggants to destroy CBRNE (polymers, paints) for optimal and mission-specific dispers taggants for optimal release and coverage. 	s for the detection and identification of CBRNE agents. E agents. Incorporate taggants into a variety of media sal. Model dispersion properties of polymer-encapsulated					
 (U) (U) CONGRESSIONAL ADD: Engineered Optical Materials (U) In FY 2007: Conducted Congressionally-directed effort fo Cryptography. (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. (U) 	for Quantum Cryptography. or Engineered Optical Materials for Quantum	0.978	0.000	0.000		
Project 4348	R-1 Line Item No. 8 Page-17 of 28		Exhibit R-2a	(PE 0602102F)		

	Exhibit R-2a, RDT&E Project Jus	DA	TE February	/ 2008	
BUD(02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT N 4348 Mate Optics, ar	NUMBER AND TITLE aterials for Electronics, and Survivability	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	CONGRESSIONAL ADD: Electronic Type-specific Buckytubes for Next Generat	ion Defense Electronics.	1.959	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Electronic Type-specif	ic Buckytubes for Next			
	Generation Defense Electronics.				
(\mathbf{U})	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(0)	CONGRESSIONAL ADD: Exprication and Processing of Adaptive Ontics and On	tical Materials	1 370	0.000	0.000
	In FY 2007: Conducted Congressionally-directed effort for Fabrication and Process	1.570	0.000	0.000	
(0)	Optical Materials.	sing of Haapuve opties and			
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Quantum Wire Program for Defense.		0.978	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Quantum Wire Program	n for Defense.			
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wide Bandgap Materials Integration for Power Electro	onic, Sensor, and Optical Devices.	2.838	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Wide Bandgap Materia	lls Integration for Power			
	Electronic, Sensor, and Optical Devices.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Engineered Non-Linear Optical Materials f	or Critical Wavelengths.	0.000	0.955	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct Congressionally-directed effort for Advanced Engineered No.	on-Linear Optical Materials for			
	Le EX 2000. Not Applicable				
(\mathbf{U})	In FY 2009: Not Applicable.				
(0)	CONCRESSIONAL ADD: Free Electron Loser Conshilities for Aerospace Microf	abrigation	0.000	1 580	0.000
(0)	In EV 2007: Not Applicable	abilitation.	0.000	1.307	0.000
	R-1 Line	e Item No. 8			
Pro	ect 4348 Page	-18 of 28		Exhibit R-2a	(PE 0602102F)
		84			

	Exhibit R-2a, RDT&E Projec	DA	TE February	/ 2008	
BUD(02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NU 4348 Mate Optics, an	IUMBER AND TITLE erials for Electronics, nd Survivability	
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Conduct Congressionally-directed effort for Free Electron Las Microfabrication.	ser Capabilities for Aerospace	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U)	CONGRESSIONAL ADD: Gallium Nitride (GaN) RF Power Technology. In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Gallium Nitride (GaN) RF Power Technology.	0.000	1.589	0.000
(U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Large Area, APVT Materials Development for In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Large Area, APV	0.000	1.589	0.000	
(U) (U) (U) (U) (U) (U)	 Devices. In FY 2009: Not Applicable. CONGRESSIONAL ADD: Plasma-Sphere Array for Flexible Electronics. In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Plasma-Sphere A 	rray for Flexible Electronics.	0.000	1.589	0.000
(U) (U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Polymer Nanocomposites for Energy Storage a In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Polymer Nanocor Dowar	and Pulsed Power. mposites for Energy Storage and Pulsed	0.000	0.796	0.000
(U) (U) (U)	In FY 2009: Not Applicable. Total Cost		26.687	29.751	21.480
Proj	ect 4348	R-1 Line Item No. 8 Page-19 of 28		Exhibit R-2a	(PE 0602102F)

	Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008	
BUDGET ACTIVITY 02 Applied Research				PE NUMBER A 0602102F M	ND TITLE Iaterials		PROJECT NUMBER AND TITLE 4348 Materials for Electronics, Optics, and Survivability		
(U) <u>C. Other Program Funding Sum</u>	<u>mary (\$ in Milli</u>	ons)							
	<u>FY 2007</u> Actual	<u>FY 2008</u> 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	Complete Total Cost	
 (U) Related Activities: (U) PE 0603112F, Advanced Materials for Weapon Systems. (U) PE 0602202F, Human Effectiveness Applied Research. (U) PE 0602204F, Aerospace Sensors. (U) PE 0603211F, Aerospace Technology Dev/Demo. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. 									
Draiget 4249			R-1 Lin	e Item No. 8					

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 02 A	ET ACTIVITY pplied Research			F	PE NUMBER AND D602102F Mat	O TITLE erials		PROJECT NUMBER AND TITLE 4349 Materials Technology for Sustainment		
	Cost (\$ in Millions)	FY 2007 Actual	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	21.550	27.642	18.662	17.692	17.590	18.698	18.771	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project develops materials and materials delivered systems, transitioning more relial characterizing materials processes and prop commands and repair centers. Repair techn non-metallic structures, coatings, corrosion essential to ensure optimum quality in the o detect the onset of any service-initiated dar	als processing to ble and maintain perties necessar niques and none control proces design and prod nage and/or det	echnologies to nable materials y for materials lestructive insp ses, and to supp uction of aircra erioration due	support operat , establishing a transition, and ection/evaluat port integration aft, propulsion, to aging of ope	ional Air Force a capability to d providing quic ion (NDI/E) me n of composite s , and missile system erational system	mission areas l etect and chara k reaction supp thods are deve structures for ac stems. These N is.	by providing the cterize perform ort and failure loped that are perspace system IDI/E methods	he ability to insp nance threatening analysis to the needed for meta ms. Various NI s are also essent	pect the quality ng defects, operational allic and DI/E methods a ial to monitor a	of re nd
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop NDI/E techn propulsion systems, and complex, low-ob	(\$ in Millions) hologies to iden servable (LO) r	tify and charac	terize damage	in aging aerosp	ace structures,	<u>FY</u>	<u>7 2007</u> 6.046	<u>FY 2008</u> 6.303	<u>FY 2009</u> 6.890
(U)	In FY 2007: Developed computer simular of multiple NDI/E technologies for depot (multi-layer) aging aircraft structures with systems for use in battle damage assessme	tions and mode level inspection complex geoment and for inspect	s of NDI/E tec s. Developed etries. Develo ection followin	hnique respons NDI/E technol ped advanced g battle damag	se to enable rap logies for inspec LO NDI/E metl ge repair.	id assessment ction of thick hods and				
(U)	In FY 2008: Mature modeling and simula for depot level inspections. Validate NDI structures with complex geometries. Initia turbine engines and thermal protection system	tion methodolo /E technologies ate studies of has stems.	gies for rapid a for inspection arsh environme	assessment of r of thick (multi ent sensors to e	multiple NDI/E i-layer) aging ai nable health ma	technologies ircraft anagement for				
(U)	In FY 2009: Demonstrate novel NDI/E m materials and components for aerospace s (multi-layer) aging aircraft structures with temperature, strain, pressure, and vibration wiring systems, and thermal protection sy	nethods and tech ystems. Demon a complex geom n to enable on-o stems.	niques to deten astrate NDI/E t etries. Develo lemand health	ct and track da echnologies fo p sensing tech status of turbin	mage in a wide or inspection of nology to detec ne engines, aircr	variety of thick t changes in raft structures,				
(U) (U) (U)	MAJOR THRUST: Develop support capa the repair of aircraft structures and to redu In FY 2007: Evaluated corrosion and eros	abilities, inform ice aircraft corr sion resistance	ation, and proc osion. of new and emo	esses to resolverging material	ve problems wit	h materials in tionally fielded		7.401	4.859	5.163
Proje	ect 4349			R-1 Line Ite Page-21 87	em No. 8 of 28				Exhibit R-2a (I	PE 0602102F)

	Exhibit R-2a, RDT&E Project	DA	TE February	/ 2008		
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT N 4349 Mate Sustainm	T NUMBER AND TITLE aterials Technology for ment		
(U)	B. Accomplishments/Planned Program (\$ in Millions) Air Force systems. Evaluated methodologies to test failure limits for MEMS s	tructures and subsystems. Validated	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Develop advanced techniques to evaluate corrosion and erosion r materials used in operationally fielded Air Force systems. Develop advanced r repair Air Force legacy systems and test failure limits for emerging Air Force s the effects of materials processes, such as the application of residual stress on t metals, to support customer focused studies and point design solutions that wil components on Air Force systems. Demonstrate technologies for improved ma materials and designs, such as conductive outer-mold-line, applique, door edge systems.	esistance of new and emerging materials and processes technology to systems. Initiate analysis to understand the surface of steel and other structural l extend the life of specific aintainability of advanced LO es and seals, and multifunctional				
(U)	In FY 2009: Validate advanced techniques to evaluate corrosion and erosion r materials used in operationally fielded Air Force systems. Evaluate advanced r repair Air Force legacy systems and test failure limits for emerging Air Force s techniques to understand the effects of materials processes, such as the applica steel and other structural metals, to support studies and point design solutions t structural components on Air Force systems. Demonstrate and transition techn of advanced LO materials and designs, such as conductive outer-mold-line, app multifunctional systems.	esistance of new and emerging materials and processes technology to systems. Develop test methods and tion of residual stress on the surface of that will extend the life of specific nologies for improved maintainability plique, door edges and seals, and				
(U) (U)	MAJOR THRUST: Develop support capabilities, information, and processes t	to resolve materials problems and	4.906	5.749	6.609	
(U)	provide electronic and structural failure analysis of components. In FY 2007: Performed failure analysis and materials investigations for field, a Demonstrated electrostatic discharge protection technologies and procedures for Validated new test methodologies for analyzing structural failures of emerging Evaluated and validated wiring materials technologies to replace aging wiring for emerging weapons systems	acquisition, and depot organizations. or emerging avionics subsystems. materials for Air Force systems. systems and new wiring technologies				
(U)	In FY 2008: Perform quick response failure analysis and materials investigation organization, depot system materials failures, and provide advanced materials and safety of flight. Develop advanced electrostatic discharge protection techna avionics subsystems. Demonstrate advanced test methodologies for analyzing materials for Air Force systems. Develop advanced wiring materials technolog	ons for fielded system, acquisition solutions to ensure system availability nologies and procedures for emerging structural failures of emerging gies to replace aging wiring systems				
Proi	ect 4349	1 Line Item No. 8 Page-22 of 28		Exhibit R-2a	(PE 0602102F)	
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	Exhibit R-2a, RDT&E Project Justif	DA	TE February	/ 2008	
BUD(02 A	GET ACTIVITY F pplied Research (PE NUMBER AND TITLE 1602102F Materials	PROJECT N 4349 Mate Sustainme	NUMBER AND TITLE terials Technology for nent	
(U)	B. Accomplishments/Planned Program (\$ in Millions) and new wiring technologies for emerging weapons systems.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Perform quick response failure analysis and materials investigations for for organization, depot system materials failures, and provide advanced materials solution and safety of flight. Develop advanced electrostatic discharge protection technologies avionics subsystems. Demonstrate advanced test methodologies for analyzing structur materials for Air Force systems. Develop advanced wiring materials technologies to r and new wiring technologies for emerging weapons systems.	Telded system, acquisition s to ensure system availability and procedures for emerging ral failures of emerging eplace aging wiring systems			
(U)					
(U)	MAJOR THRUST: Develop enabling technologies to reduce the Air Force LO mainter 2008, afforts in this thrust will be combined with other major thrusts in this project	enance burden. Note: In FY	0.825	0.000	0.000
(U)	In FY 2007: Developed technologies for improved maintainability of advanced LO m conductive outer-mold-line, applique, door edges and seals, multifunctional systems, a	aterials and designs, such as nd embedded LO NDI/E.			
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Accelerated Insertion of Advanced Materials for Material Repair-National Institute for Aviation Research.	s Substitution and	1.272	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Accelerated Insertion of A Materials Substitution and Repair-National Institute for Aviation Research.	dvanced Materials for			
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U) (U)	CONCRESSIONAL ADD: Accelerated Insertion of Advanced Materials and Cartific	ation for Militamy Aircraft	1 100	2 792	0.000
(0)	Structure Material	ation for Mintary Alteratt	1.100	2.785	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Accelerated Insertion of A Certification for Military Aircraft Structure Material Substitution and Repair.	dvanced Materials and			
(U)	In FY 2008: Conduct Congressionally-directed effort for Accelerated Insertion of Adv	vanced Materials and			
	Certification for Military Aircraft Structure Material.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Aircraft Active Corrosion Protective Compounds.		0.000	0.993	0.000
Pro	ect 4349 R-1 Line Ite Page-23	m No. 8 of 28		Exhibit R-2a	(PE 0602102F)
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		Exhibit R-	2a, RDT&E	Project Jus	tification			D/	DATE February 2008		
BUD(02 A	GET ACTIVITY Applied Research				PE NUMBER A 0602102F N	ND TITLE Iaterials		PROJECT N 4349 Mate Sustainm	ECT NUMBER AND TITLE Materials Technology for ainment		
(U)	B. Accomplishments/Planned Prog	<u>gram (\$ in Mil</u>	lions)				I	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Not Applicable.										
(U)	In FY 2008: Conduct Congressiona	lly-directed effe	ort for Aircraft	Active Corrosion	n Protective Cor	npounds.					
(U)	In FY 2009: Not Applicable.										
(U)											
(U)	CONGRESSIONAL ADD: Institute Simulation.	e for Science an	d Engineering	Simulation (ISE	S) / Aircraft Fat	igue Modeling a	nd	0.000	2.484	0.000	
(U)	In FY 2007: Not Applicable.										
(U)	In FY 2008: Conduct Congressiona Aircraft Fatigue Modeling and Simu	lly-directed effe	ort for Institute	for Science and	Engineering Sir	nulation (ISES) /					
(U)	In FY 2009: Not Applicable.										
(U)											
(U)	CONGRESSIONAL ADD: Polyme	r Stress and Sei	nsor Damage Se	ensors for Comp	osites.			0.000	2.882	0.000	
(U)	In FY 2007: Not Applicable.										
(U)	In FY 2008: Conduct Congressiona	lly-directed effe	ort for Polymer	Stress and Sense	or Damage Sens	ors for					
	Composites.										
(U)	In FY 2009: Not Applicable.										
(U)											
(U)	CONGRESSIONAL ADD: Science	e for Sustainmer	nt Initiative to I	mprove Mission				0.000	1.589	0.000	
(U)	In FY 2007: Not Applicable.										
(U)	In FY 2008: Conduct Congressiona	lly-directed effe	ort for Science f	for Sustainment	Initiative to Imp	rove Mission.					
(U)	In FY 2009: Not Applicable.										
(U)											
(U)	Total Cost							21.550	27.642	18.662	
(U)	C. Other Program Funding Summa	ary (\$ in Millio	ons)								
		FY 2007	 FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 201	3 Cost to		
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estima	te Complete	<u>Total Cost</u>	
(U)	Related Activities:								<u> </u>		
(U)	PE 0603112F, Advanced										
Ì Í	Materials for Weapons Systems.										
(U)	PE 0603211F, Aerospace										
Ì	Technology Dev/Demo.										
				R-1 Line	e Item No. 8						
Pro	iect 4349			Page	-24 of 28				Exhibit R-2a	(PE 0602102F)	
					90						

Exhibit R-2a, RDT&	Exhibit R-2a, RDT&E Project Justification							
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NUMBER AND TITLE 4349 Materials Technology for Sustainment						
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. 								
(U) D. Acquisition Strategy Not Applicable.								
Project 4349	R-1 Line Item No. 8 Page-25 of 28 91	Exhibit R-2a (PE 0602102F)						

	Exh	nibit R-2a, F	RDT&E Pro	ject Justifi	cation			DATE	February	2008
BUD 02 /	GET ACTIVITY Applied Research			P 0	e number and 602102F Mat	TITLE erials		PROJECT NUME	BER AND TITLE	Fechnology
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
491	5 Deployed Air Base Technology	6.750	11.308	3.646	2.706	2.734	2.899	3.005	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U)	A. Mission Description and Budget Item This project develops new deployable airba and survivability of deployed Air Expedition force protection to improve Expeditionary of	Justification use technologies onary Force (AF Combat Suppor	to reduce airli EF) warfighters t operations.	ft and manpow . Affordable, e	ver requirement efficient techno	s, setup times, a logies are deve	and sustainmer loped for base	nt costs, and to infrastructure,	improve protec fire fighting, a	ction nd
(U)	B. Accomplishments/Planned Program	(\$ in Millions)					<u>FY</u>	2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	MAJOR THRUST: Develop new deploya setup times, and sustainment costs in supp In FY 2007: Developed high-efficiency set technologies and demonstrated logistic fue stabilizer interaction with airfield matting nondestructive inspection of airfield surface reagents for producing reduced cost, tailor In FY 2008: Develop and analyze solar pe for acquisition. Begin development of adv temperature effects on operating surfaces a airfield surface evaluation technologies. In materials. In FY 2009: Analyze and demonstrate ren advanced integrated power technologies.	able airbase tech port of AEF ope olar shelter fabr el processing pl and begin mod- ce anomalies. S red characteristi ower for bare be vanced integrate and develop rep Demonstrate cos newable power Evaluate and de	nologies to rec rations. ics. Develope anar technolog el development Synthesized poi cs in aerospace ase application ed power technology st effectiveness technologies ap evelop mitigati	duce airlift and d advanced hea y. Investigated t. Developed n lymer materials e materials. s. Transition fu ologies. Invest . Demonstrate and performar opplicable to dep	manpower req at and mass trar l behavior of so on-radar wave s using biocatal uel cell reformet tigate and evalu nondestructive nee of synthesiz	uirements, hsfer oil and methods of lysts and er specification hate high inspection of zed polymer Demonstrate is on operating		1.939	1.226	1.650
	surfaces. Demonstrate and analyze nonde	structive inspec	tion of airfield	surface evalua	tion technologi	les.				
(U) (U)	MAJOR THRUST/CONGRESSIONAL A survivability to AEF deployed warfighters of \$3.1 million in FY 2007 (\$2.0 million f million for Fire and Blast Resistant Mater	ADD: Develop and infrastruct or Blast Resistation for Force P	affordable tech ure. Note: Th int Panels for E rotection).	nnologies to pro is effort includ Buildings, Shelt	ovide force protession es Congression ers, and Vehic	tection and al Add funding les and \$1.1		4.811	1.338	1.996
(U)	In FY 2007: Demonstrated emerging fire individual fire fighter effectiveness techno structural materials and methodologies for technologies to protect against the ballistic	suppression tec ologies for a con improved prot c and fragmenta	hnologies for i nbined technol ection of struct tion effects of	ntegrated crash ogy demonstra ures and inhab improvised exp	n/rescue capabi tion. Demonst itants. Develop plosive device	lity. Integrated rated resilient ped threats, and				
Pro	ject 4915			R-1 Line Iter Page-26	m No. 8 of 28				Exhibit R-2a (PE 0602102F)

	Exhibit R-2a, RDT&E Project J	ustification	DA	TE February	2008
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602102F Materials	PROJECT NU 4915 Deple	IMBER AND TITLE	Technology
(U)	B. Accomplishments/Planned Program (\$ in Millions) initiated protective material development against high energy threats. Developer atmospheric models for protection of deployed warfighters from asymmetric three	d characterization data for eats.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Develop methodologies to characterize candidate fire suppression a supporting fire suppression technologies for crash/rescue. Develop and evaluate fighter effectiveness. Demonstrate and analyze effectiveness of resilient structure improved protection of structures and inhabitants. Investigate and analyze effective explosive detection and defeat for high energy threat. Investigate mechanisms of evaluate accuracy for atmospheric models for protection of deployed warfighters.	gents and begin development of combined technologies for fire al materials and methodologies for iveness of innovative improvised f gas phase kinetics. Develop and from asymmetric threats.			
(U)	In FY 2009: Develop and demonstrate methodologies to characterize candidate to develop supporting fire suppression technologies for crash/rescue. Develop a for fire fighter effectiveness. Validate and demonstrate resilient structural mater protection of structures and inhabitants. Develop and demonstrate effectiveness high energy threats.	fire suppression agents and continue and analyze combined technologies ials and methodologies for improved of innovative defeat of IED and			
(U)	CONCRESSIONAL ADD: Blast Products		0.000	1 580	0.000
(U)	In FY 2007: Not Applicable.		0.000	1.569	0.000
(U) (U)	In FY 2008: Conduct Congressionally-directed effort for Blast Resistant Concre In FY 2009: Not Applicable.	te Products.			
(U)					
(U)	CONGRESSIONAL ADD: Life Shield Blast Resistant Panels.		0.000	0.995	0.000
(U) (U)	In FY 2007: Not Applicable.	stant Danala			
(0)	In FY 2008: Conduct Congressionary-unected errort for Life Shield Blast Resis	stant Paneis.			
(U)					
(U)	CONGRESSIONAL ADD: Fire and Blast Resistant Materials for Force Protect	on.	0.000	1.589	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct Congressionally-directed effort for Fire and Blast Resistant	nt Materials for Force Protection.			
(U)	In FY 2009: Not Applicable.				
(U)			0.000	2 0 0 2	0.000
(U)	CONGRESSIONAL ADD: Advanced Carbon Fiber Research and Testing Initia	tive.	0.000	2.982	0.000
(U) (U)	In FY 2007. Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Advanced Carbon Fib	er Research and Testing Initiative.			
(-)					
Pro	R-1 I	ine Item No. 8 age-27 of 28		Exhibit R-2a	(PE 0602102F)
		-			

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER A 0602102F M	ND TITLE I aterials		PROJECT NUMBER AND TITLE 4915 Deployed Air Base Technol		
(U) (U)	B. Accomplishments/Planned Pr In FY 2009: Not Applicable.	rogram (\$ in Mil	llions)				F	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) (U) (U) (U) (U) (U) 	CONGRESSIONAL ADD: Adva In FY 2007: Not Applicable. In FY 2008: Conduct Congression In FY 2009: Not Applicable.	nnced Aerospace (Carbon Foam H Fort for Advance	eat Exchangers. d Aerospace Ca	rbon Foam Heat	Exchangers.		0.000	1.589	0.000
(U) (U)	Total Cost							6.750	11.308	3.646
(U) (U) (U) (U)	C. Other Program Funding Summa Related Activities: PE 0603112F, Advanced Materials for Weapon Systems. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	mary (\$ in Millio FY 2007 Actual	ons) FY 2008 Estimate	<u>FY 2009</u> <u>Estimate</u>	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Pro	ject 4915			R-1 Line Page	e Item No. 8 -28 of 28				Exhibit R-2a	(PE 0602102F)
					94					

PE NUMBER: 0602201F

SBIR/STTR Transfer

(U) Significant Program Changes:

Exhi	bit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDGET ACTIVITY 02 Applied Research			PE 0	E NUMBER AND	o TITLE ospace Vehic	le Technolog	gies		
Cost (\$ in Millions)	FY 2007 Actual	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	115.423	139.855	122.870	143.289	145.056	140.955	142.111	Continuing	TBD
22SP Applied Space Access Vehicle Tech	3.688	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
2401 Structures	44.663	37.890	37.411	51.243	50.081	44.424	57.697	Continuing	TBD
2403 Flight Controls and Pilot-Vehicle Interface	36.253	42.032	33.477	36.791	38.931	38.040	37.150	Continuing	TBD
2404 Aeromechanics and Integration	30.819	59.933	51.982	55.255	56.044	58.491	47.264	Continuing	TBD
 (U) <u>A. Mission Description and Budget Iten</u> This program investigates, develops, and a aeromechanics. Advanced structures cond technologies are developed and simulated experiments, and multi-disciplinary analys aerospace vehicles. Note: In FY 2008, C for Cognitive Unmanned Air Vehicle, \$0. Airborne Environment for Tactaical Laser This program is in Budget Activity 2, Ap aerospace vehicle technologies. (U) D. D. C. C.	a Justification analyzes aerospace for aerospace ve sis. Resulting te- ongress added \$ 9 million for Mo rs, and \$0.7 milli plied Research, s	ce and access to d and develope chicles. Advanc chnologies redu 1.9 million for A deling and Sim on for Single-M since it develop	o space vehicle d to exploit new ced aerodynam ace life cycle co Advancement o ulation for Rap Iode Optical C s and determin	e technologies i w materials, fal ic vehicle conf osts and impro- of Intelligent A oid Integration onnectors for A es the technica	n the three prin brication proces igurations are c ve the performa erospace System and Technolog Advanced Air V I feasibility and	hary areas of st sees, and design leveloped and a nce of existing ns (AIAS) for y Evaluation, \$ y evaluation, \$ y ehicles.	ructures, contro n techniques. F analyzed throug and future man the U.S. Air Fo 3.9 million for y of evolutionar	ols, and Flight control gh simulations, nned and unma orce, \$0.9 millio Characterization ry and revolution	nned on on of onary
(U) <u>B. Program Change Summary (\$ in Mi</u>	<u>illions)</u>					FY 2007	FY 2	2008	FY 2009
(U) Previous President's Budget						118.901	131	.948	119.637
(U) Current PBR/President's Budget						115.423	139	.855	122.870
(U) Total Adjustments						-3.478	7	.907	
(U) Congressional Program Reductions									
Congressional Rescissions						0.001	-0	.893	
Congressional Increases							8	.800	
Reprogrammings						-1.478			

-2.001

Exhib	it R-2, RDT&E Budget Item Justification	DATE February 2008
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technol	ologies
Not Applicable. (U) C. Performance Metrics Under Development		
	R-1 Line Item No. 9 Page-2 of 17	Exhibit R-2 (PE 0602201F)

Exh	ibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDGET ACTIVITY 02 Applied Research			F Q T	PE NUMBER AND 0602201F Aero Fechnologies	TITLE ospace Vehic	le	PROJECT NUMI 22SP Applie Tech	BER AND TITLE d Space Acce	ess Vehicle
Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	TDD
22SP Applied Space Access Vehicle Tech	3.688	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	IBD
Note: In FY 2007 Project 6266SP Applied Spa	ce Access Vehi	cle Technolog	v efforts were	transferred from	DE 0602500F	0 F Multidiscipl	jary Space Tecl	l hnology Projec	t 625030
 Applied Space Access Vehicle Technology, in or priorities. (U) <u>A. Mission Description and Budget Item</u> This project develops technologies in areas Resulting technologies contribute significar warfighter include enhanced mission effective. (U) <u>B. Accomplishments/Planned Program (U)</u> (U) MAJOR THRUST: Develop advanced strands and developed integenvelope. (U) In FY 2009: Net Applicable. 	der to effective Justification of advanced str ntly towards the iveness, improv (<u>\$ in Millions</u>) ucture, flight co access to space. rated guidance	ely manage and ructures, flight e development yed flight safet ontrol, and aero and control lav	l provide overs controls, and a of reliable, res y, improved m odynamic tech ws to expand th	sight of the effor aerodynamics to ponsive space a aintenance, and nologies to enat ne launch vehicl	enable afforda ccess systems of decreased size ole horizontal e performance	ble on-deman with aircraft-li weight, and c	d military access ke operations. cost. <u>7 2007</u> 3.688	to higher Air F ss to space. Payoffs to the <u>FY 2008</u> 0.000	FY 2009 0.000
 (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. (U) (U) Total Cost 							3.688	0.000	0.000
 (U) <u>C. Other Program Funding Summary (\$</u> <u>FY</u> <u>FY</u> <u>A</u> (U) Related Activies: (U) PE 0603211F, Aerospace Technology Dev/Demo. (U) <u>D. Acquisition Strategy</u> Not Applicable. 	<u>in Millions)</u> 2007 <u>FY</u> Actual <u>Es</u>	<u>7 2008 F</u> stimate <u>F</u>	Y 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	<u>FY 2012</u> <u>Estimate</u>	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Project 22SP			R-1 Line Ite Page-3 0 97	em No. 9 of 17				Exhibit R-2a (PE 0602201F)

	ExI	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DAT	E February	2008
BUD(02 A	GET ACTIVITY Applied Research			P 0 T	E NUMBER AND 602201F Aer echnologies	o TITLE ospace Vehic	cle	PROJECT NUI 2401 Struct	MBER AND TITLE	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ in Winnons)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
240	1 Structures	44.663	37.890	37.411	51.243	50.081	44.424	57.69	7 Continuing	TBD
<u> </u>	Quantity of RDT&E Articles	0	0	0	0	0	0		0	
(U) (U)	This project develops advanced structures New structural concepts include incorporat and adaptive mechanisms into the actual ai manned and unmanned aerospace vehicles improved operability and maintainability of B. Accomplishments/Planned Program MAJOR THRUST: Develop an economi methodologies, and structural health mon	concepts to exp ting subsystem l ircraft structures structures, while of aerospace veh (\$ in Millions) c service life an itoring schemes	oit new materi hardware items and/or skin of providing incr icles. alysis capabilit	als and fabricat (e.g., antennas the aircraft. R reased capabilit y comprised of	tion processes a s, sensors, direc tesulting techno ties. Payoffs to f analysis tools,	and investigates ted energy wea ologies strength the warfightes	s new structur upon compone en and extend r include redu <u>E</u>	al concepts an ents, and integr I the life of cur ced weight and <u>Y 2007</u> 2.082	d design techniqu rated energy stora rrent and future d cost, as well as <u>FY 2008</u> 3.705	les. age) <u>FY 2009</u> 3.593
(U)	In FY 2007: Continued development of s Continued the development of economic aircraft, enhancing capabilities, component analysis tools into life prediction and failut temperature aircraft components and cond	structural health service life anal nt replacement, ure analysis. Co cepts.	management s ysis and structu and technology ontinued to dev	chemes for stru tral design tool direction. Inc elop failure crit	actures suscepti s for current an corporated new teria tools for a	ble to damage. Id future ly developed dvanced high				
(U)	In FY 2008: Based upon results of demon refine development of structural health m development of economic service life ana capabilities, component replacement, and prediction and failure analysis. Continue components and concepts.	nstration efforts anagement sche lysis and structu technology dire to develop failu	in PE 0603211 mes for structu ural design tool ection. Continu re criteria tool	F - Aerospace ares susceptible is for current ar the developm is for advanced	Technology D to damage. Co ad future aircra nent analysis to high temperatu	ev/Demo, ontinue the ft, enhancing ools into life re aircraft				
(U)	In FY 2009: Continue development of sta Continue the development of economic se enhancing capabilities, component replac into life prediction and failure analysis. C aircraft components and concepts.	ructural health r ervice life analy ement, and tech Continue to deve	nanagement sc sis and structur nology directic elop failure crit	hemes for struc ral design tools on. Continue th eria tools for ac	ctures susceptib for current and he development dvanced high te	le to damage. l future aircraft analysis tools emperature	,			
(U)	1 I									
(U)	MAJOR THRUST: Develop methodolog cost and time involved in actual full-scale	gies to allow for testing of com	analytical airw conents and air	orthiness certif	fication that wil btaining airwor	ll reduce the thiness		7.058	3.716	3.322
Pro	ject 2401			R-1 Line Iter Page-4 c	m No. 9 of 17				Exhibit R-2a (I	PE 0602201F)
				98						

	Exhibit R-2a, RDT&E Project Jus	stification	DA	February	/ 2008
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT N 2401 Stru	UMBER AND TITLE Ctures	
(U)	B. Accomplishments/Planned Program (\$ in Millions) certification. Note: In FY 2008 and out decrease due to completion of medium- a analytical certification methodologies that improve airworthiness certification proc	nd high-fidelity and real-time	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Continued development of analytical certification methodologies that concepts, diagnostic techniques, and manufacturing technologies into aircraft com Completed development of medium- and high-fidelity and real-time analytical cert improve airworthiness certification process and reduce development and testing fo to dynamics loads.	incorporate advanced methods, ponents and airframe design. ification methodologies that r aircraft and components subject			
(U)	In FY 2008: Continue development of analytical certification methodologies that is concepts, diagnostic techniques, and manufacturing technologies into aircraft complication newly developed analysis in real-time analytical certification methodologies and reduce development and testing for aircraft and component	ncorporate advanced methods, ponents and airframe design. logies that improve airworthiness			
(U)	In FY 2009: Continue development of analytical certification methodologies that is concepts, diagnostic techniques, and manufacturing technologies into aircraft comp Initiate development of high-fidelity and continue real-time analytical certification airworthiness certification process and reduce development and testing for aircraft dynamics loads	incorporate advanced methods, ponents and airframe design. methodologies that improve and components subject to			
ക	dynamics loads.				
(U)	MAJOR THRUST: Develop design methods to capitalize on new materials and in hardware items (e.g., antennas, sensors, direct energy weapon components, and int adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft.	tegration of various subsystem egrated energy storage) and	18.822	17.442	17.118
(U) (U)	In FY 2007: Continued the development, evaluation, and assessment of design and components that enable the integration of structures with other air vehicle function well as increase the survivability and performance of future systems. Continued the assessment, and ground testing of adaptive structures, subsystem hardware, and an structures to create multi-function or ultra-lightweight concepts. Completed feasible energy storage concepts that are integrated into load-bearing structures. Complete and initiated evaluation and testing of critical subsystem hardware integration methweapons to be carried out on future air vehicles. Initiated development, analysis, a technologies that integrate active aeroelastic design concepts, adaptive structures, a technologies to enable viable long-range and long endurance air vehicle concepts. In FY 2008: Continue the development, evaluation, and assessment of design and	analysis methods and s to reduce cost and weight, as the development, evaluation, tenna integration into load-bearing ility determination efforts of d the development and analysis, mods that enable directed energy and evaluation of innovative and aerodynamic flow control analysis methods and components			
l	R-1 Lin	e Item No. 9			
Pro	Pag	e-5 of 17		Exhibit R-2a	(PE 0602201F)

	Exhibit R-2a, RDT&E Proje	ct Justification	D	ATE February	y 2008
BUDC 02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT N 2401 Stru	IUMBER AND TITLE I CTURES	
(U)	B. Accomplishments/Planned Program (\$ in Millions) that enable the integration of structures with other air vehicle functions to re the survivability and performance of future systems. Continue the develop testing of adaptive structures, subsystem hardware, and antenna integration multi-function or ultra-lightweight concepts. Continue development, analy innovative technologies to advance active aero elastic design concepts, adaptechnologies, system health reasoners, and active denial concepts. Initiate development, evaluation, and assessment of multi-function demonstration of energy storage concepts, integrated distributed electronics systems	educe cost and weight, as well as increase ment, evaluation, assessment, and ground into load-bearing structures to create vsis, evaluation, and simulation of ptive structures, aerodynamic flow control characterization of high energy laser onal structures to include ground s, and homogeneous sensor integration	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue the development, evaluation, and assessment of desit that enable the integration of structures with other air vehicle functions to re- the survivability and performance of future systems. Initiate analysis for ca- antenna structure. Continue the development, evaluation, assessment, and a subsystem hardware, and antenna integration into load-bearing structures to concepts, which provides for increased energy efficiencies. Continue devel simulation of innovative technologies to advance active aero elastic design aerodynamic flow control technologies, system health reasoners, and active characterization of high energy laser concepts. Continue development, eva multi-functional structures to include ground demonstration of energy stora electronics, and homogeneous sensor integration systems.	ign and analysis methods and components educe cost and weight, as well as increase apabilities for conformal load bearing ground testing of adaptive structures, o create multi-function or ultra-lightweight lopment, analysis, evaluation, and concepts, adaptive structures, e denial concepts. Continue aluation, and assessment of age concepts, integrated distributed			
(U) (U)	MAJOR THRUST: Develop technologies that will permit the structural de	evelopment of aircraft that can operate at	16.701	13.027	13.378
(U)	In FY 2007: Further developed technologies that incorporate advanced ma creation of an integrated air vehicle structure that can withstand extreme fli improved durability of existing and future aerospace vehicle structures resu Completed development of concepts germane to advanced, all weather, dur attachment techniques; vehicle health management; hot primary structures; tanks.				
(U)	In FY 2008: Further develop technologies that incorporate advanced mater of an integrated air vehicle structure that can withstand extreme flight envir	rials and design concepts for the creation ronments. Technologies will improve			
Proj	ject 2401	R-1 Line Item No. 9 Page-6 of 17		Exhibit R-2a	(PE 0602201F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD 02 /	GET ACTIVITY Applied Research		PE NUMBER AND TITLEPROJE0602201F Aerospace Vehicle2401Technologies				JECT NUMBER AND TITLE 1 Structures			
(U) (U)	B. Accomplishments/Planned P durability of existing and future a newly developed structural conce In FY 2009: Further develop tech of an integrated air vehicle structu durability of existing and future a newly developed structural conce	rogram (\$ in Mil erospace vehicle s pts and analysis m mologies that inco ire that can withst erospace vehicle s pts and analysis m	lions) structures result nethods for desi- prporate advanc and extreme flig structures result nethods for desi-	ing in reduced c gn and evaluatic ed materials and ght environment ing in reduced c gn and evaluatic	ost and increased on of hot primary design concepts s. Technologies ost and increased on of hot primary	d life. Incorpora structure. for the creation will improve d life. Incorpora structure.	E ite ite	<u>7 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Total Cost							44.663	37.890	37.411
	C. Other Program Funding Sum Related Activities: PE 0602102F, Materials. PE 0603112F, Advanced Materials for Weapon Systems. PE 0603211F, Aerospace Technology Dev/Demo. PE 0604015F, Next Generation Bomber. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>mary (\$ in Millic</u> <u>FY 2007</u> <u>Actual</u>	ms) 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>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Pro	ject 2401			R-1 Lin Pag	e Item No. 9 e-7 of 17 101				Exhibit R-2a	(PE 0602201F)

	Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUD(02 A	GET ACTIVITY pplied Research			P 0 T	E NUMBER AND 602201F Aer echnologies	o TITLE ospace Vehic	cle	PROJECT NUME 2403 Flight C Interface	BER AND TITLE	Pilot-Vehicle
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2403	Interface	36.253	42.032	33.477	36.791	38.931	38.040	37.150	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project develops technologies that ena are developed for maximum vehicle perfor towards the development of reliable autom to the warfighter include enhanced mission Leverages a network of synthetic environm	able maximum a rmance through omous unmanne n effectiveness, o nents for evaluat	ffordable capa out the flight en d air vehicles, optimized flightion of advance	bility from man nvelope and sin space access sy nt safety, increa ed concepts.	nned and unma nulated in virtu ystems with airo ised survivabilit	nned aerospace al environment craft-like opera ty, improved m	e vehicles. Ad s. Resulting to tions, and exte aintenance, an	vanced flight co echnologies con inded-life legac d decreased siz	ontrol technolog tribute significa y aircraft. Payo e, weight, and c	gies antly offs cost.
(U) (U)	B. Accomplianments/Planned Program MAJOR THRUST: Develop advanced fl systems for both manned and unmanned a reducing the size, weight, and cost of com increased emphasis being placed on incom control systems.	ight control syst aircraft. In addit trol and prognos	ems, compone tion to increase stic systems. N om air vehicle	ents, and integra ed reliability, ef Note: Increased monitoring cor	ated vehicle hea fforts will also t I funding in FY nponents into t	alth monitoring focus on 2008, is due to he flight	<u>FY</u> 1	5.482	<u>FY 2008</u> 20.515	<u>FY 2009</u> 18.088
(U) (U)	In FY 2007: Furtherd the development a highly reliable operations for manned and size, weight, and cost. Developed high-d subsystem size, weight, and cost while co- using high-density optical components. Ovalidation and verification of complex, and analysis tools for reconfigurable control st techniques for unmanned system situation integrated vehicle health management. In FY 2008: Further the development and highly reliable operations for manned and size, weight, and cost. Complete develop environments that reduce subsystem size, design for safety-critical electromagnetic for the affordable validation and verificat	nd assessment of l unmanned syst ensity optical co- onsidering maint Continued to dev laptive, and auto systems. Compl- nal awareness in d assessment of l unmanned syst oment of high-de , weight, and cos- tolerant systems ion of complex,	f advanced corr ems under adv mponent techn ainability. Des relop and asses onomous contre- eted the evalua aerospace ope advanced cont ems under adv nsity optical co t while consid s. Complete th adaptive, and	ntrol mechaniza verse environme nologies for adv signed systems so tools and pro- ol software. Re- ation of sensing erations. Refine rol mechanizati verse environme omponent techn ering maintaina a assessment o autonomous co	ation technologients at significativerse environments of safety-critication of the safety-critication of the safety-critication of the safety-critication of technologies and associated ed technologies for advantational software.	es to provide ntly reduced ents that reduced cal control ffordable gies and interpretation that permit s to provide ntly reduced verse et systems is and processes Complete	5			
Proj	ect 2403			R-1 Line Iter Page-8 c	m No. 9 of 17				Exhibit R-2a (F	PE 0602201F)
				102	2				`	
	Exhibit R-2a, RDT&E Project Just	DA	TE February	2008						
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BUDC 02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT N 2403 Fligh Interface	JMBER AND TITLE at Controls and	Pilot-Vehicle					
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) refinement of actuation fault compensation technologies for integrated vehicle health In FY 2009: Further the development and assessment of advanced control mechaniz highly reliable operations for manned and unmanned systems under adverse environm size, weight, and cost. Initiate development of control architecture enhancements to ease validation and verification for complex and adaptive unmanned systems. Initiat low-maintenance/fault tolerant control-effector technology for aerospace applications	management. ation technologies to provide nents at significantly reduced enable design for certification to e development of s.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>					
(U) (U) (U)	MAJOR THRUST: Develop flight control systems that will permit safe interoperabi and unmanned aircraft. Concepts will also provide mission responsiveness and adap effectiveness of manned and unmanned systems. In FY 2007: Continued to develop and assess novel control automation techniques a enable safe and interoperable application of manned and unmanned aerospace system reliability and performance analysis of self-organizing, distributed control of multi-u formations. Initiated development and assessment of cooperative control techniques	lity between manned aircraft tability for improved operational nd adaptive algorithms to as. Continued to enhance nmanned vehicle flight for close-in surveillance of	9.630	9.817	8.665					
(U)	urban environments. Initiated control and situational awareness requirements develo unmanned vehicles in terminal area and ground operations. In FY 2008: Continue to develop and assess novel control automation techniques an safe and interoperable application of manned and unmanned aerospace systems. Cor performance analysis of self-organizing, distributed control of multi-unmanned vehic development and assessment of cooperative control techniques for close-in surveillar Complete control and situational awareness requirements development for interoperat terminal area and ground operations. Develop and assess adaptive guidance and con	pment for interoperability of d adaptive algorithms to enable atinue to enhance reliability and cle flight formations. Continue ace of urban environments. bility of unmanned vehicles in trol technologies for								
(U)	tault/damage tolerant aerospace vehicle operations. In FY 2009: Continue to develop and assess novel control automation techniques an safe and interoperable application of manned and unmanned aerospace systems. Cor performance analysis of self-organizing, distributed control of multi-unmanned vehic development and assessment of cooperative control techniques for close-in surveillar Initiate technology development for interoperability of unmanned vehicles in termina Continue to develop and assess adaptive guidance and control technologies for fault/ vehicle operations.	d adaptive algorithms to enable nplete reliability and ele flight formations. Complete nce of urban environments. Il area and ground operations. damage tolerant aerospace								
(U)	R-1 Line I	tem No. 9								
PIO	rage)3		EXHIDIL R-28	(PE 0602201F)					

	TE February	/ 2008				
BUD(02 A	GET ACTIVITY PE Applied Research 06 Te	NUMBER AND TITLE 02201F Aerospace Vehicle chnologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicl Interface			
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	future aircraft.	earch and development of	6.758	6.932	6.724	
(U)	In FY 2007: Completed assessments of advanced manned and unmanned aerospace cor	ncepts in simulated future				
	environments. Completed analysis of long endurance intelligence, surveillance, and reconnetwork centric environment. Conducted technology trade studies for next generation that the analysis of new concepts in access to space missions. Conducted analyses of new converte environments.	onnaissance platforms in a eater transports. Conducted ncepts in hostile urban				
(U)	In FY 2008: Refine network-centric environment to broaden advanced technology assess breadth of simulation analyses in refined net-centric environment to address multi-direct studies for refined long-range strike and reconnaissance concepts. Continue technology generation theater transports. Conduct simulations to analyze advanced launch and reem access to space concepts. Continue technology to a studies of small and madium sized					
	hostile urban environments.	unmanned air venicies in				
(U)	In FY 2009: Refine network-centric environment to broaden advanced technology assess breadth of simulation analyses in refined net-centric environment to address multi-direct studies for refined long-range strike and reconnaissance concepts. Continue technology generation theater transports. Conduct simulations to analyze advanced launch and reem access-to-space concepts. Continue technology trade studies of small and medium sized hostile urban environments.	sment capability. Expand orate technology trade trade studies for next try technologies for unmanned air vehicles in				
(U)			0.007	0.000	0.000	
(U) (U)	CONGRESSIONAL ADD: Sentient Adaptive Systems Technology for Vehicle Condition In FY 2007: Conducted Congressionally-directed effort for sentient adaptive systems technology for Vehicle Condition-based maintenance.	on-Based Maintenance. chnology for vehicle	0.996	0.000	0.000	
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Neurobiologically Autonomus Vehicle Operations		2 391	0.000	0.000	
(U) (U)	In FY 2007: Conducted Congressionally-directed effort for neurobiologically autonomu	s vehicle operations.	2.371	0.000	0.000	
(U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.					
Pro	R-1 Line Item	No. 9 17		Exhibit R-2a	(PE 0602201E)	
110	104	••		Exhibit N 2d	(1 - 00022011)	

	Exhibit R-2a, RDT&E Project	DA	TE February	y 2008	
BUD(02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT N 2403 Fligh Interface	UMBER AND TITLE	I Pilot-Vehicle
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	CONGRESSIONAL ADD: Unmanned Air Vehicle Research.		0.996	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for unmanned air ver	hicle research.			
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advancement of Intelligent Aerospace Systems	(AIAS) for the U.S. Air Force	0.000	1.987	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct Congressionally-directed effort for Advancement of In	itelligent Aerospace Systems (AIAS) for			
	the U.S. Air Force				
(\mathbf{U})	In FY 2009: Not Applicable.				
(U)	CONCRESSIONAL ADD: Cognitive Unmenned Air Vehicle		0.000	0.003	0.000
(0)	In FY 2007: Not Applicable		0.000	0.995	0.000
(0)	In FY 2008: Conduct Congressionally-directed effort for Cognitive unmann	ed air vehicles			
	In FY 2009: Not Applicable	ee an venicies.			
(U)					
(U)	CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integration a	and Technology Evaluation	0.000	0.993	0.000
(U)	In FY 2007: Not Applicable				
(U)	In FY 2008: Conduct Congressionally-directed effort for Modeling and Sim	ulation for Rapid Integration and			
	Technology Evaluation				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Single-Mode Opitcal Connectors for Advanced	Air Vehicles	0.000	0.795	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct Congressionally-directed effort for Single-Mode Opit	tcal Connectors of Advanced air			
	vehicles.				
(U)	In FY 2009: Not Applicable.				
(U)	T . 1.0		2 < 2 2 2	12.022	00.455
(U)	Total Cost		36.253	42.032	33.477
	я	R-1 Line Item No. 9			
Pro	ect 2403	Page-11 of 17		Exhibit R-2a	(PE 0602201F)
		105			

	Exhibit R-	2a, RDT&E	Project Jus	stification				DATE February	2008
BUDGET ACTIVITY 02 Applied Research				PE NUMBER A 0602201F A Technologi	ND TITLE erospace Veh es	nicle	PROJEC 2403 FI Interfac	T NUMBER AND TITLE	Pilot-Vehicle
(U) <u>C. Other Program Funding Su</u>	<u>mmary (\$ in Milli</u>	<u>ons)</u>							
	FY 2007 Actual	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimate	<u>FY 2</u> Estir	<u>2013</u> <u>Cost to</u> mate Complete	<u>Total Cost</u>
 (U) Related Activities: (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. 						Listinidu			
Project 2403			R-1 Lin Page	e Item No. 9 e-12 of 17				Exhibit R-2a	(PE 0602201F)
				106					

Exh	ibit R-2a, F	DT&E Pro	ject Justifi	ication				date Fe	bruary 2	2008
BUDGET ACTIVITY 02 Applied Research			P 0 T	PE NUMBER AND TITLEPRO.0602201F Aerospace Vehicle2404Technologies2404			PROJECT 2404 Ae	ROJECT NUMBER AND TITLE 404 Aeromechanics and Integration		
Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	2 FY 2013		ost to	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estima	ate Co	omplete	
2404 Aeromechanics and Integration	30.819	59.933	51.982	55.255	56.044	58.491	47	7.264 Co	ontinuing	TBD
Quantity of RDT&E Articles	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) In FY 2007: Continued efforts to develop a air vehicles in future missions, including of Continued to perform mission assessment a surveillance and weapon delivery. Initiated vehicle designs to achieve reduced drag and Continued to develop technologies for imp air vehicles. (U) In FY 2009: Continued for the develop technologies for imp air vehicles. 	 MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles. In FY 2007: Continued efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continued to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Initiated development and evaluation of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance on low speed vehicles. Continued to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles. 									
 In FY 2008: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continue to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Continue development and evaluation of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance on low-speed vehicles. Initiate development of fluid-based thrust vectoring concept for unmanned air vehicle. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles. J) In FY 2009: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles. J) In FY 2009: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles. J) In FY 2009: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles. J) un FY 2009: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continue to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Initiate development of innovative aerodynamic control methods for small unmanned air vehicles. Refine development of fluid-based thrust vectoring concept for unmanned air vehicle. 										
Project 2404			R-1 Line Iter Page-13 (107	m No. 9 of 17				Ext	hibit R-2a (F	PE 0602201F)

	Exhibit R-2a, RDT&E Proje	D/	February	/ 2008	
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT N 2404 Aero	UMBER AND TITLE	d Integration
(U)	B. Accomplishments/Planned Program (\$ in Millions) Continue to develop technologies for improved weapon delivery and propu air vehicles.	lsion system performance in unmanned	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop new and improved concepts, designs, and ana	alysis of technologies to enable	15.857	26.731	21.262
	revolutionary capabilities for sustained high-speed flight and re-useable hig Note: In FY 2008 and out, increased emphasis has been placed on assessin high-speed air vehicle concepts. Note: Provide support to SECAF-directe Fuels Initiative) to identify and develop technologies that provide revolutio the use of domestic fuel sources for military energy needs.				
(U)	In FY 2007: Continued development and assessment of aerospace technolo flight to permit global reach. Continued development of integrated airfram- high-speed aerospace vehicles. Conducted sub-scale aerodynamic testing of efficiency aero configurations for system level performance validation. De structures for lightweight integrated exhaust systems and airframes. Condu- advance control techniques for low-speed and high-speed operation. Devel simulations to verify system level operability. Completed development of a flow field over high-speed vehicles to significantly reduce drag.				
(U)	In FY 2008: Continue development and assessment of aerospace technolog flight to permit global reach. Continue development of integrated airframe high-speed aerospace vehicles. Initiate study of energy-based analysis and design. Evaluate supersonic tailless aerodynamic concepts. Initiate efforts and develop and validate fundamental hypersonic component technologies a relevant high-speed environment. Initiate efforts to integrate self-defense system threats. Evaluate sub-scale aerodynamic integrated inlet concepts of system level performance. Evaluate thermally integrated structures for ligh airframes. Continue high fidelity aerodynamic testing of advance control to operation. Validate analytical stability and control simulations for system 1 to SECAF-directed effort (Energy Conservation - Assured Fuels Initiative) provide revolutionary aircraft configurations that enable the use of domestic	gies that enable sustained high-speed propulsion design concepts for optimization techniques for vehicle to characterize hypersonic phenomena through experimental flight techniques in e systems to counter multi-spectrum on high efficiency aero configurations for ntweight integrated exhaust systems and echniques for low-speed and high-speed level operability. Note: Provide support to identify and develop technologies that c fuel sources for military energy needs.			
(U)	In FY 2009: Continue development and assessment of aerospace technolog flight to permit global reach. Continue development of integrated airframe	gies that enable sustained high-speed propulsion design concepts for			
Pro	ect 2404	R-1 Line Item No. 9 Page-14 of 17		Exhibit R-2a	(PE 0602201F)
		108			

	Exhibit R-2a, RDT&E Pr	DATE February 2008			
BUDGE 02 Ap	ET ACTIVITY oplied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT N 2404 Aero	UMBER AND TITLE	d Integration
(U) 1	B. Accomplishments/Planned Program (\$ in Millions) high-speed aerospace vehicles. Continue efforts to integrate self-defent threats. Initiate advanced high-speed aero/flight control development. high-temperature flexible structural materials and fluid mechanics of i shock/boundary layer interaction control. Initiate study of exhaust sys- initiate cold-flow testing of sub scale components. Continue efforts to develop and validate fundamental high-speed component technologies relevant environment. Note: Provide support to SECAF-directed effor Initiative) to identify and develop technologies that provide revolution of domestic fuel sources for military energy needs.	ase systems to counter multi-spectrum system Initiate study of interaction of high-load, nlet. Initiate component development enabling stems for advanced hypersonic vehicles, and o characterize high-speed phenomena and s through experimental flight techniques in a ort (Energy Conservation - Assured Fuels hary aircraft configurations that enable the use	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop new and improved concepts, designs, an revolutionary capabilities for re-useable, high altitude vehicle. Note:	d analysis of technologies to enable In FY 2008 and out, increased emphasis has	1.792	6.717	7.965
(U)	been placed on assessing the next generation long-range, high-speed a In FY 2007: Developed and assessed aerospace technologies that enal development and evaluation of computational, multi-disciplinary, exp control the flow fields around advanced concepts for ultra-high-speed environments, including staging. Completed development of techniqu aerodynamic configurations to validate aero thermodynamic prediction	ir vehicle concepts. ble reuseable, high altitude vehicle. Completed erimental, and analytical tools to simulate and aerospace vehicles in extreme flight ues to evaluate transatmospheric vehicle ns and analysis techniques.			
(U)	In FY 2008: Continue development and assessment of aerospace tech vehicle. Develop robust design methodology and integration approace extensive application and 3D validation experience in applying aeroth ground-tested and flight-tested vehicles traveling at high-speeds. Dev materials in support of re-usable space-access aircraft. Pursue multi-orspeed high temperature, reusable air vehicles	nologies that enable reusable, space-access thes for high-speed aeropropulsion. Develop ermal computational tools to conceptual, elop unique high temperature structures and disciplinary optimization of complex high			
(U)	In FY 2009: Continue development and assessment of aerospace tech vehicle. Enhance robust design methodology and integration approach extensive application and 3D validation experience in applying aeroth ground-tested and flight-tested vehicles traveling at high-speeds. Refi materials in support of high speed re-usable space-access aircraft. Concomplex high-speed, high temperature, reusable air vehicles. Initiate of high-speed space-access air vehicle system.	nologies that enable reusable, space-access hes for high-speed aeropropulsion. Continue ermal computational tools to conceptual, ne unique high temperature structures and ntinue multi-disciplinary optimization of design and test of components of integrated			
Projec	ct 2404	R-1 Line Item No. 9 Page-15 of 17		Exhibit R-2a	(PE 0602201F)

	February	y 2008			
BUDG 02 A j	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT N 2404 Aero	UMBER AND TITLE omechanics an	d Integration
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	MAJOR THRUST: Develop enabling technologies to allow integration of future air vehicle platforms.	directed energy weapons into current and	1.739	2.278	1.205
(U)	In FY 2007: Completed development and evaluation of critical aeronautica weapons to be carried on future air vehicles, including maneuvering fighter Completed measurements of the actual aero-optics effects encountered whe aircraft.	al technologies that enable directed energy aircraft, to improve combat effectiveness. en employing a laser weapon on a fighter			
(U)	In FY 2008: Initiate development of combined flow control and adaptive of system performance on large low speed aircraft. Initiate development of an performance of advanced flow control and adaptive optics systems				
(U)	In FY 2009: Continue development of combined flow control and adaptive energy system performance on large low-speed aircraft. Continue development performance of advanced flow control and adaptive optics systems.	e optics systems to optimize directed ment of analysis tools for predicting the			
(U) (U)	MAJOR THRUST: Develop and assess technologies for the next generation FY 2008 and out, investment is increasing due to higher Air Force priority	on of multi-role large aircraft. Note: In for next generation large aircraft.	5.934	16.171	18.042
(U)	In FY 2007: Furthered development and assessment of aeronautical technol transonic, and structural that enable revolutionary tanker and transport aircu Continued to develop technologies that enable multiple roles and missions	blogies including high lift systems, raft designs for rapid global mobility.			
(U)	In FY 2008: Continue development and assessment of aeronautical techno transonic, and structural concepts that enable revolutionary tanker and trans- mobility. Continue to develop technologies that enable multiple roles and t	logies including high-lift systems, sport aircraft designs for rapid global missions for delivery and support aircraft.			
	Initiate trade studies between short take-off and landing performance, and h inlet and integration technologies for an advanced mobility platform design speeds and provide short take off capabilities	nigh-speed cruise. Initiate development of ned to operate efficiently at transonic			
(U)	In FY 2009: Continue development and assessment of aeronautical technol transonic, and structural concepts that enable revolutionary tanker and trans mobility. Continue to develop technologies that enable multiple roles and n Optimize configuration for trade-off between short take-off and landing per	logies including high-lift systems, sport aircraft designs for rapid global missions for delivery and support aircraft. rformance, and high speed cruise.			
	Continue development of inlet and integration technologies for an advanced efficiently at transonic speeds and provide short take-off capabilities.	d mobility platform designed to operate			
Proj∉	ect 2404	R-1 Line Item No. 9 Page-16 of 17		Exhibit R-2a	(PE 0602201F)

	Exhibit R-2a, RDT&E Project Justification							DATI	February	/ 2008	
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER AND TITLEPROJE0602201F Aerospace Vehicle2404 JTechnologies2404 J			PROJECT NUM	ECT NUMBER AND TITLE Aeromechanics and Integration		
(U)	B. Accomplishments/Planned Pro	ogram (\$ in Mil	llions)				E	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	CONGRESSIONAL ADD: Wrigh Tactical Lasers.	t Brothers Instit	ute (WBI) - Cha	racterization of	Airborne Enviro	onment for		2.192	3.975	0.000	
 (U) In FY 2007: Conducted Congressionally-directed effort for WBI - characterization of airborne environment for tactical lasers. (U) In FY 2008: Conducted Congressionally-directed effort for WBI - characterization of airborne environment for tactical lasers. (II) In FY 2009. No. 1, 11, 11, 11, 11, 11, 11, 11, 11, 11,											
(U) (U)	In FY 2009: Not Applicable.										
(U)	Total Cost							30.819	59.933	51.982	
(U)	C. Other Program Funding Summ	<u>nary (\$ in Milli</u>	<u>ons)</u>								
		<u>FY 2007</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete	Total Cost	
(U) (U) (U) (U)	Related Activities: PE 0603211F, Aerospace Technology Dev/Demo. PE 0604015F, Next Generation Bomber. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.										
Pro	ject 2404			R-1 Lin Page	e Item No. 9 17 of 17		1		Exhibit R-2a	(PE 0602201F)	

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

	Exhibit R-2, RDT&E Budget Item Justification								February	2008
BUDGE 02 App	FACTIVITY Died Research	P 0	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research							
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ III WIIIIons)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	106.435	92.068	82.091	92.603	82.481	87.555	90.356	Continuing	TBD
1123	Warfighter Training	17.933	16.916	13.602	13.091	13.245	14.098	14.177	Continuing	TBD
7184	Decision Effectiveness & Biosciences	63.435	51.468	49.496	60.024	51.006	54.464	57.091	Continuing	TBD
7757	Bioeffects and Protection	25.067	23.684	18.993	19.488	18.230	18.993	19.088	Continuing	TBD
1										

(U) A. Mission Description and Budget Item Justification

This program establishes technical feasibility and develops technology for protecting and enhancing human effectiveness for Air Force weapon systems and for operational readiness. The program addresses warfighter training, deployment and sustainment of forces in extreme environments, warfighter system interface, biodynamic response, directed energy bioeffects, crew performance and protection, and counterproliferation. The Warfighter Training project focuses on the development and evaluation of new methods and technologies to enhance Air Force training and education. The Decision Effectiveness and Biosciences project develops and evaluates technologies that will improve human performance and combat effectiveness. The Bioeffects and Protection project develops technologies to predict and mitigate the biological effects of multiple military unique stressors in extreme environments or during sustained operations, directed energy, and other threats on personnel and mission performance. Note: In FY 2008, Congress added \$1.6 million for Warfighter Pocket XP-Next Gen, \$1.6 million for Imaging Tools for Human Performance Enhancement and Diagnostics, \$0.8 million for Ubiquitous RFID Chem/Bio Detection, \$4.0 million for Component Object Model (COM) Attitude Control System Simulation/Trainer, \$3.2 million for Solid Electrolyte Oxygen Separator, and \$1.6 million for MAICE. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.

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

			<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget		109.174	79.856	79.377
(U)	Current PBR/President's Budget		106.435	92.068	82.091
(U)	Total Adjustments		-2.739	12.212	
(U)	Congressional Program Reductions			-0.010	
	Congressional Rescissions			-0.578	
	Congressional Increases			11.200	
	Reprogrammings		-1.146	1.600	
	SBIR/STTR Transfer		-1.593		
(U)	Significant Program Changes:				
	Not Applicable.				
	C. Performance Metrics				
		R-1 Line Item No. 10			
		Page-1 of 22		Exhibit F	-2 (PE 0602202F)

Exhibit R-2,	, RDT&E Budget Item Justification	DATE February 2008
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness A	pplied Research
Under Development.		
	R-1 Line Item No. 10 Page-2 of 22	Exhibit R-2 (PE 0602202E)
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	Ex	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 02 A	GET ACTIVITY pplied Research			P 0 4	PE NUMBER AND 0602202F Hun Applied Resea	TITLE nan Effective arch	eness	PROJECT NUME 1123 Warfigh	BER AND TITLE Inter Training	
	Cost (\$ in Millions)	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	Complete	February 2008 R AND TITLE Cost to Total Complete TBD Continuing TBD ning; technical igates the edge from the odologies, and odologies, and FY 2009 1.593 FY 2009 1.814
1123	8 Warfighter Training	17.933	16.916	13.602	13.091	13.245	14.098	14.177	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project identifies and analyzes new m training; mission rehearsal; training in sup spectrum of new and advanced technologi cognitive and neural sciences with informa- simulation technologies to achieve maxim readiness by providing more effective met personnel at a reduced cost.	nethods and tech port of complex es to design and ation technology um learning effe hods and approa	nologies to imp decision-maki implement trai to create desk ctiveness for s ches to train an	prove Air Force ng; information ning, and to eve top tutors, count pecific needs and assess perso	e training and e n warfare traini valuate training rseware develop at minimum cos onnel. This proj	ducation. The ng; and warfigl effectiveness. oment tools and t. These techno- ect contributes	research focus hter readiness It combines fu l technologies ologies and mo to a more hig	ses on aircrew tr training. It inve undamental kno , assessment me ethods will incre hly trained and	raining; technica estigates the wledge from the ethodologies, an ease operational flexible cadre o	al e d
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Explore perceptual i technologies to enhance Distributed Miss visual requirements necessary for realisti train as they intend to fight.	(\$ in Millions) ssues involving sion Operations (c aircrew trainin	the developmen DMO) and dec g and mission :	nt of new visua rision dominan rehearsal, allow	al and sensor sin nce environment wing Air Force	mulation ts. Identify the warfighters to	FY	<u>ř 2007</u> 2.304	<u>FY 2008</u> 1.593	<u>FY 2009</u> 1.814
(U)	In FY 2007: Researched and analyzed ke technologies including resolution, image delay. Performed human training researc visual system requirements for air-to-gro	ey perceptual pe stability, target th of head-moun und and compos	formance para racking databa ted and deploy ite force trainin	meters for new se characterist able displays. 1g.	v deployable vis fics, accuracy, a Researched and	sual display nd transport d evaluated				
(U)	In FY 2008: Research perceptual issues allow for greater realistic composite force display technologies. Expand human fac collaborative environment for DMO.	for out-the-wind e training. Explo tors visual resea	ow display and ore perceptual or rch to define di	l targeting pod characteristics splay requiren	simulation syst for new deploy nents for a fully	tems that will able visual immersive				
(U)	In FY 2009: Perform human factors and air-to-ground and air-to-air composite for evaluations of compact immersive displa AF mission areas and initiate research on	ysis, tests, and e ree training using y concepts and c sensory-driven	valuations of v g air-to-surface omponents. T decision makir	isual and sense operational te ransition result g in complex of	or simulation co estbed. Conduct ts to address bro environments.	omponents for t perceptual bader range of				
(U) (U)	MAJOR THRUST: Research and analyz mission training, rehearsal, and operation	e tools, strategie s for aircrews a	s, and perform nd command ar	ance support n and control force	nethods for imp es. Apply the e	roving combat mpirical data		8.081	7.986	8.208
Proje	ect 1123			R-1 Line Iter Page-3 d	m No. 10 of 22				Exhibit R-2a (F	PE 0602202F)

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 02 Applied Research 1123 Warfighter Training (U) B. Accomplishments/flamed Program (5 in Millions) EX 2009 to develop guidelines for improving learning in training for combat air forces and global strike operations. Enhances the quality, management, and effectiveness of all aspects to TDMO, live operations training, rehearsal and exercise environments through the identification and application of competency-based training methods. Explore EX 2007 EX 2008 EX 2009 (1) IN 2007: Evaluated capability conserves learning and opplication of competency-based training methods. Explore Texa 2009 EX 2009 EX 2009 EX 2009 (1) In Y 2007: Evaluated capability conserves learning and proficiency widin live, virtual, and constructive operational contexts. Identified metrics and developed preliminary guidelines for intrial, refresher, and continuation training and rehearsal. Identified common competency requirements and valuated instructional designs for commont, with realistic, interactive content and training rehearsal, and exercise environments. Content and reining in the adapted for use within and across missions. Created a learning management-based migration plan indigets for integrating principles of learning in live, virtual, and constructive operational training rehearsal and bools to manage learning in operational training contexts. Identify and analyze methods of routine yasses ing knowledge and skalls for combat readiness. Analyze field data to identify opportunities of contenenees bearening in operational readiness. Analyze field data to ide		Exhibit R-2a, RDT&E Project Ju		DATE February 2008		
(1) B. Accomplishments/Planued Program (S In Millions) FY 2007 FY 2008 FY 2009 (1) B. Accomplishments/Planued Program (S In Millions) FY 2009 FY 2009 FY 2009 (1) B. Accomplishments/Planued Program (S In Millions) FY 2009 FY 2009 FY 2009 (1) B. Accomplishments/Planued Program (S In Millions) FY 2009 FY 2009 FY 2009 (1) In FY 2007 Evaluated capability conserves of all aspects of DMO. [we operations training, rehearsal and exercise environments through the identification and applications or competency-based training methods. Explore teaching in the status or compliance in and future systems and threads. (1) In FY 2007. Evaluated capability to assess learning and proficiency within live, virtual, and constructive operational training requirements across operational mission areas. Analyzed fully immersive, just-in-time training environments, with realistic, interactive contens and training strategies that can be adapted for use within and across missions. Created a learning management-based migration plan for integrating full fidelity training and rehearsal systems with more generalizable software -dividences contexts. Identify and analyze methods for competency-based training integration. Analyze for lata to identify opportunities for competency-based training integration. Analyze for lata to identify opportunities for competency-based training integration. Analyze for lata to identify opportunities for complex-based training integration. Analyze for lata to identify opportunities for complex-based training inteplastal. Analyze for lata t	BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJEC 1123 W	T NUMBER AND TITLE	
 In FY 2007: Evaluated capability to assess learning and proficiency within live, virtual, and constructive operational contexts. Identified metrics and developed preliminary guidelines for initial, refresher, and continuation training and rehearsal. Identified common competency requirements and evaluated instructional designs for common training management-based migration plan for integrating full fieldity training and across missions. Created a learning management-based migration plan for integrating full fieldity training and rehearsal systems with more generalizable software-driven training, rehearsal, and exercise environments. In FY 2008: Evaluate approaches and tools for integrating principles of learning in live, virtual, and constructive environments. Identify methods and tools to manage learning in operational training contexts. Identify and analyze methods of routinely assessing knowledge and skills for combat readiness. Analyze field data to identify opportunities for competency-based training integration. Analyze how to monitor the integration of distributed training and rehearsal into operational training, rehearsal, and exercise events. Explore scenario sequencing methods for continuous learning. Conduct in depth analysis of the training integration on distributed training and rehearsal. Explore hardware and software solutions allowing functional processing of selected friendly/memy interactions for extremely high fidelity training. Research and analyze parameters for a network server for high-fidelity weapons models which allows real- or near real-time processing of DMO interactions for more accurate weapons effects and engagements. In FY 2009: Develop tools to permit AF planners and managers to integrate completency-based migration and allows real- or near real-time processing of DMO interactions for more accurate weapons effects and engagements. In FY 2009: Develop tools to permit AF planners and managers to integrate completency-based fore co	(U)	B. Accomplishments/Planned Program (\$ in Millions) to develop guidelines for improving learning in training for combat air forces and the quality, management, and effectiveness of all aspects of DMO, live operation environments through the identification and application of competency-based tra technologies that will enable DMO and mission rehearsals to run new, complex to real-time. Apply results to provide vastly improved synthetic forces and aircraft high fidelity electronic warfare, aerodynamic, and weapons effect models that ac capabilities of both current and future systems and threats.	d global strike operations. Enhances as training, rehearsal and exercise ining methods. Explore models/simulations at real- or near simulator capabilities that feature curately represent the actual	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) In FY 2008: Evaluate approaches and tools for integrating principles of learning in live, virtual, and constructive environments. Identify methods and tools to manage learning in operational training contexts. Identify and analyze methods of routinely assessing knowledge and skills for combat readiness. Analyze field data to identify opportunities for competency-based training integration. Analyze how to monitor the integration of distributed training and rehearsal into operational readiness contexts. Evaluate common measurement tools for assessing readiness in air-to-air, air-to-ground, and close air support training, rehearsal, and exercise events. Explore scenario sequencing methods for continuous learning. Conduct in-depth analysis of the training related shortfalls of current DMO computer generated forces. Explore hardware and software solutions allowing functional processing of selected friendly/enemy interactions for extremely high fidelity training. Research and analyze parameters for a network server for high-fidelity weapons models which allows real- or near real-time processing of DMO interactions for more accurate weapons effects and engagements. (U) In FY 2009: Develop tools to permit AF planners and managers to integrate competency-based methods into readiness parameters and assessment in operational training, rehearsal, and exercise. Identify alternative approaches for evaluating the individual, team, and team of team (coalition) performance impacts of collaborative, distributed spin-up training and rehearsal. Evaluate integrated instructional development and management methods for continuous learning in operational contexts. Identify functional requirements for instructor operator 	(U)	In FY 2007: Evaluated capability to assess learning and proficiency within live, contexts. Identified metrics and developed preliminary guidelines for initial, refrrehearsal. Identified common competency requirements and evaluated instruction requirements across operational mission areas. Analyzed fully immersive, just-in realistic, interactive content and training strategies that can be adapted for use will learning management-based migration plan for integrating full fidelity training as generalizable software-driven training, rehearsal, and exercise environments.	virtual, and constructive operational resher, and continuation training and nal designs for common training n-time training environments, with thin and across missions. Created a nd rehearsal systems with more			
 (U) In FY 2009: Develop tools to permit AF planners and managers to integrate competency-based methods into readiness parameters and assessment in operational training, rehearsal, and exercise. Identify alternative approaches for evaluating the individual, team, and team of team (coalition) performance impacts of collaborative, distributed spin-up training and rehearsal. Evaluate integrated instructional development and management methods for continuous learning in Live, Virtual, and Constructive (LVC) contexts and explore task allocation methods for performance aiding and training in operational contexts. Identify functional requirements for instructor operator R-1 Line Item No. 10 Page-4 of 22 	(U)	In FY 2008: Evaluate approaches and tools for integrating principles of learning environments. Identify methods and tools to manage learning in operational train methods of routinely assessing knowledge and skills for combat readiness. Anal opportunities for competency-based training integration. Analyze how to monitor training and rehearsal into operational readiness contexts. Evaluate common me readiness in air-to-air, air-to-ground, and close air support training, rehearsal, and sequencing methods for continuous learning. Conduct in-depth analysis of the tr DMO computer generated forces. Explore hardware and software solutions allow selected friendly/enemy interactions for extremely high fidelity training. Researce network server for high-fidelity weapons models which allows real- or near real- interactions for more accurate weapons effects and engagements.	in live, virtual, and constructive ning contexts. Identify and analyze yze field data to identify or the integration of distributed asurement tools for assessing d exercise events. Explore scenario aining related shortfalls of current wing functional processing of ch and analyze parameters for a time processing of DMO			
Project 1123 Page-4 of 22 Exhibit R-2a (PE 0602202F)	(U)	In FY 2009: Develop tools to permit AF planners and managers to integrate con readiness parameters and assessment in operational training, rehearsal, and exerc for evaluating the individual, team, and team of team (coalition) performance im spin-up training and rehearsal. Evaluate integrated instructional development an continuous learning in Live, Virtual, and Constructive (LVC) contexts and explo performance aiding and training in operational contexts. Identify functional requ R-1 L	npetency-based methods into ise. Identify alternative approaches pacts of collaborative, distributed d management methods for re task allocation methods for the task allocation methods for the start of the start o			
	Pro	ect 1123 P	age-4 of 22		Exhibit R-2a (F	PE 0602202F)

Exhibit R-2a, RDT&E Project	DA	February	/ 2008	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT N 1123 War	UMBER AND TITLE	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> station capabilities. Investigate and evaluate physics-based directed energy th improved rule sets to enhance training utility of computer generated forces. A avoidance and rehearsal training combining selected aerodynamic models, dir visual special effects.	reat models for DMO systems. Define ssess feasibility of enhanced threat ected energy models, and validated	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) (U) MAJOR THRUST: Explore performance improvement techniques to enhance realistic mission training environments. Develop enabling technologies for in assortment of AF career fields, from combat air forces to command and control 	e aerospace operational training in pproving readiness across an ol personnel.	2.937	3.362	3.580
(U) In FY 2007: Integrated the communication model with a synthetic communic training value. Verified and validated the knowledge and skill tracking predic Implemented initial semi-automated parameter search capability with high per models.	ation agent/teammate and assessed tion models with actual training data. formance computing for moderator			
 (U) In FY 2008: Expand the depth of the communication models to support the furused in the AOC training environment. Conduct empirical study with skill accuration functionality to include dynamic model validity and refinement call. (U) In FY 2000. Ensured the breadth of the communication model to support and the breadth. 	all range of vocabulary and grammar quisition/retention models. Extend pability.			
(U) In FY 2009: Expand the breadth of the communication model to support end- knowledge and skill tracking prediction system with mission essential compet for airmen and demonstrate ability to produce individualized training program acquisition/retention models. Validate semi-automated, adaptive parameter se capability and implement graphical user interface for performance moderator	encies to predict training requirements s. Conduct empirical study with skill earch and model optimization prediction system.			
 (U) (U) CONGRESSIONAL ADD: Airman Performance Integration (AIRPRINT). (U) In FY 2007: Conducted Congressionally-directed effort for AIRPRINT. (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 		1.964	0.000	0.000
 (U) (U) (U) CONGRESSIONAL ADD: Component Object Model (COM) Attitude Contr (U) In FY 2007: Conducted Congressionally-directed effort for COM Attitude Cont (U) In FY 2008: Conduct Congressionally-directed effort for COM Attitude Cont (U) In FY 2009: Not Applicable. (U) 	ol System Simulation/Trainer. ontrol System Simulation/Trainer. rol System Simulation/Trainer.	1.080	3.975	0.000
Project 1123	1 Line Item No. 10 Page-5 of 22		Exhibit R-2a	(PE 0602202F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUD(02 A	GET ACTIVITY Applied Research				PE NUMBER A 0602202F H Applied Res	ND TITLE I uman Effectiv search	reness	PROJECT NUMBER AND TITLE 1123 Warfighter Training			
(U) (U) (U) (U) (U) (U)	B. Accomplishments/Planned Pr CONGRESSIONAL ADD: C4IS In FY 2007: Conducted Congress In FY 2008: Not Applicable. In FY 2009: Not Applicable.	rogram (\$ in Mil R Fusion System ionally-directed e	<mark>lions)</mark> effort for C4ISR	Fusion System			F	<u>Y 2007</u> 1.567	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000	
(U)	Total Cost							17.933	16.916	13.602	
(U) (U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602233N, Human Systems Technology. PE 0602716A, Human Factors Engineering Technology. PE 0602785A, Personnel Performance and Training Technologies. PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0604227F, Distributed Mission Training (DMT). This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>mary (\$ in Millic</u> <u>FY 2007</u> <u>Actual</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> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>	
Pro	ect 1123			R-1 Line Pag	e Item No. 10 e-6 of 22				Exhibit R-2a (PE 0602202F)	
					118						

	Ext	nibit R-2a, F	RDT&E Pro	oject Justifi	ication			DATE	February	2008
BUDG 02 A	ET ACTIVITY pplied Research			P 0 4	PE NUMBER AND 0602202F Hun Applied Resea	TITLE nan Effective arch	eness	PROJECT NUM 7184 Decisio Biosciences	IBER AND TITLE On Effectivene	ess &
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
7184	Decision Effectiveness & Biosciences	Actual 63 435	Estimate 51.468	49 496	Estimate 60.024	Estimate 51.006	Estimate 54 464	Estimate 57 091	Continuing	TBD
/104	Ouantity of RDT&E Articles	0	0		00.024	0	0	0	Continuing	
(II)	A Mission Description and Budget Item	Justification		•				•	•	
	biodynamic response, and survivability in o seeks to improve logistical support for peace of systems operators; it determines human noise, impact, vibration, and maneuvering a interface. It produces human-centered desi technologies for information display, team experiments and evaluations of control inte and tools to identify and minimize the risks life cycle cost.	dispersed opera cetime and com responses to mi acceleration, an gn criteria, guid communication erfaces, crew sta s and mission ir	tional environr bat operations. litary unique s d it explores w delines, and de ns, and modelir ation layout and npact to AF pe	nents. By inve This research tresses such as yays to assess a sign tools for d ng and simulation d functional inter- rsonnel from ex-	stigating the tec further defines operations in su nd manage hum eveloping effec on for human-c egration, and hux xposure to milit	chnologies to en the physical ar ustained and ex- nan operator wo ctive human-sys- entered aerospa uman informati- tary unique stre	nhance deploy nd cognitive particular orkload by opt stem interfaces ace and cyber ion processing essors while al	vment capabiliti arameters, capa iments includin imizing the hur s. It develops a operations. It of g. It also develo so reducing hur	ies this program abilities, and lim g the effects of man-machine and assesses conducts ops biotechnolog man weapon sys	its gies stems
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop interface tec network-centric warfare environments. T shared, distributed decision making requir	(\$ in Millions) chnologies that hese technologies red on the mode	enhance humai les will enable ern battlefield.	n-human and hu the common op	uman-machine perational under	collaboration in rstanding and	<u>דע</u> ו	<u>¥ 2007</u> 5.765	<u>FY 2008</u> 4.958	<u>FY 2009</u> 4.997
(U) (U)	In FY 2007: Determined the risk and ben speech recognizer/synthesizer, and advance collaboration toolkit for air battle manage decision support technologies, and formul program. Demonstrated the ability of the collaboration during simulated BMC2 miss In FY 2008: Begin to develop multination advance technologies that support mobile, collaborative tools in BMC2 environment	efit of adding la ced speech proc ment command ated plans to de cognitive state ssions. nal speech trans , speech-based is s. Begin to dev	anguage, accen ressing technolo and control (E emonstrate ope assessment pac slator technolog interfaces. Cor relop a collabor	t, and domain r ogy. Complete BMC2). Develor rational benefit ckage to evalua gies for obscure mplete a style g ration toolkit for	models into the ed development oped and evalua ts in an advance tte real-time hun e languages and guide for applyin or non-airborne.	laboratory of a ated BMC2 ed technology man-machine continue to ng command and				
(U)	control missions. Expand the operator cop performance and situational awareness mo In FY 2009: Explore the use of transparen Continue development of multinational sp	gnitive state ass odels, and tactic nt multilingual peech translation	sessor to incorp cal situation inf collaboration to n technologies	porate operator formation for be ools for distribu for obscure lan	performance da etter decision su uted multi-entity aguages. Deterr	ata, operator upport. y teaming. nine the effects	5			
Proie	ect 7184			R-1 Line Iten Page-7 c	m No. 10 of 22				Exhibit R-2a (PE 0602202F)
				119)					- /

	Exhibit R-2a, RDT&E Project Jus	Exhibit R-2a, RDT&E Project Justification ACTIVITY PROJE				
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT N 7184 Deci Bioscienc	UMBER AND TITLE sion Effectiver es	E ness &	
(U)	B. Accomplishments/Planned Program (\$ in Millions) of collaboration technologies on performance efficiency, shared situation awareness for tactical command and control. Begin development of adaptive automated hum real-time human-machine task sharing. Develop predictive operator state models a workflow and workload management.	an-machine interfaces to improve and assessment tools for dynamic	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Develop cognitive system interface technologies to achieve co echelons of operations and to improve decision-making and predictive battlespace offer breakthrough potential for understanding and modeling human behavior, in o decisions, while also providing context-sensitive human-computer interfaces that s	ommon understanding at all awareness. These technologies rder to assure timely and effective upport decision effectiveness.	4.725	3.952	4.385	
(U)	In FY 2007: Developed and began the transition to advanced development of softw the standardization of human-computer interface elements in command and contro collaboration techniques and methods to embed them into command and control sy and ethnic bases of human decision making and began to develop human performa differences to enable effects-based operations	ware design patterns that enable l ISR systems. Developed ystems. Researched the cultural nce models that reflect these				
(U)	In FY 2008: Continue advancement of software design patterns that enable the sta human-computer interface elements in command and control ISR systems. Begin patterns library. Continue development of collaboration techniques and methods to command and control systems. Demonstrate collaboration techniques in a distribu Continue researching the cultural and ethnic bases of human decision making and p	ndardization and re-use of to develop a DoD software design o embed these techniques into ted net-centric environment. proceed with developing human				
(U)	In FY 2009: Expand contents of DoD software design patterns library. Begin emb graphical user interface building tools. Continue to demonstrate collaboration tech environment. Investigate how collaboration techniques can enable distributed team researching the cultural and ethnic bases of human decision making and developing reflect cultural differences to enable effects-based operations.	bedding design patterns in aniques in a distributed net-centric a self-synchronization. Continue g human performance models that				
(U)	1					
(U)	MAJOR THRUST: Establish the technology base for a decision support environm Commander, Joint Forces Air Component Commander, and command staffs to inte future battlefield mission states and to predict the intent and actions of adversaries	ent that enables the Joint Forces errelate the past, present, and during joint operations.	3.791	1.922	2.237	
(U)	In FY 2007: Developed advanced visualization techniques that enable the uncertain be incorporated into the iconic or graphic portrayal scheme for command center discontinues of the scheme for center discontinues of the schem	inty associated with information to splay. Developed and began to				
Pro	ect 7184 R-1 Line Pag	e Item No. 10 e-8 of 22		Exhibit R-2a	(PE 0602202F)	
		120				

Exhibit R-2	Exhibit R-2a, RDT&E Project Justification			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT N 7184 Dec Bioscien	NUMBER AND TITLE ision Effectiven ces	iess &
(U) B. Accomplishments/Planned Program (\$ in Milli transition to advanced development methods needed simple models of adversary behavior. Conducted la displays for dynamic battlefields. Developed knowl and complex systems of systems. Developed an inte aids to achieve persistent operational planning, persi broad national security objectives are dynamically c	ons) to simulate enemy potential courses of action, beginning with poratory experiments to evaluate "sensemaking" tools and edge representation techniques to model potential adversaries grated set of anticipatory planning and operations (APO) work stent prediction, and focused execution even as military and hanging.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2008: Begin the transition of advanced uncer Transition towards advanced development, the need including more complex adversary behavior. Evalua and displays for dynamic battlefields. Identify gaps "sensemaking" results into display development. Re adversaries and complex systems of systems and beg of APO work aids to achieve persistent operational p initial demonstration of the integration of the develo	tainty visualization techniques for command center displays. ed methods to simulate enemy potential courses of action, atter results of the laboratory experiments on "sensemaking" tools for further research. Begin incorporating the extrapolated, select effine the knowledge representation techniques to model potential gin integrating into displays. Initiate transition of integrated set planning, persistent prediction, and focused execution. Conduct ped displays and technologies.			
(U) In FY 2009: Analyze the results of the initial demon Complete the transition of advanced uncertainty visu transition of methods needed to simulate enemy pot behavior. Incorporate more extrapolated "sensemak techniques to model potential adversaries and compl Continue transitioning the integrated set of APO wo prediction, and focused execution and evaluate the e developed displays and technologies.	Astration of the integration of the displays and technologies. Inalization techniques for command center display. Continue ential courses of action, including more complex adversary ing" results into displays. Refine the knowledge representation ex systems of systems and begin integrating into displays. The aids to achieve persistent operational planning, persistent ffect. Conduct follow-on demonstration of the integration of the			
 (U) (U) MAJOR THRUST: Develop system control interface capabilities. Identify the best mix of intelligent methoperator's attention, which is critical for net-centric of quantify operational benefits from new information in 	the concepts enabling full operator exploitation of all AF platform nods and traditional design to unambiguously direct the operations. Employ real-time and wargaming simulations to portraval concepts.	4.918	4.675	4.514
 (U) In FY 2007: Demonstrated real-time assessment too prediction capability, for maximizing single operator vehicles (UAVs) within net-centric environments. E control-display concepts that reduce operator task lo 	Is and advanced decision support interfaces, including supervision of multiple highly autonomous unmanned aerial legan design and development of second generation ad and mitigate channelized attention. Began algorithm			
Project 7184	R-1 Line Item No. 10 Page-9 of 22		Exhibit R-2a	(PE 0602202F)

Exhibit R-2a, RDT&E P	DA	DATE February 2008		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT N 7184 Deci Bioscienc	UMBER AND TITLE sion Effectiven es	iess &
(U) B. Accomplishments/Planned Program (\$ in Millions) development to blend display imagery with computer-generated graph data to conduct autonomous landing and ground operations at night a	hical representations of terrain and real-time nd during adverse weather.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2008: Evaluate single operator supervision of multiple autonom real-time assessment tools and advanced decision support interfaces of Transition field test results of first generation control-display concept channelized attention into second generation control-display workstate imagery with computer-generated graphical representations of terrain fight-testing of autonomous landing and ground operations.	mous UAVs in a net-centric context using during testing and simulated ground operations. ts that reduce operator task loading and tions. Apply basic algorithms that blend display and real-time data during simulation and/or			
(U) In FY 2009: Integrate real-time assessment tools into second generat optimize operator task loading and avoid channelized attention. Use field testing and flight demonstration to control multiple, highly autor development of common interface and software architectures of contri numbers of operators to control autonomous UAVs in urban environr operations.	ion control-display operator workstations to second generation operator workstations during nomous UAVs. Begin software design and rol-display concepts that allow minimal nents and/or in large-scale, strategic military			
 (U) (U) MAJOR THRUST: Develop technologies associated with collecting for best assimilation by warfighters. Develop, evaluate, and organize system through the fusion of multi-spectral sensors, digital image pro order to enhance real-time, day/night imaging systems. Devise huma and techniques for integration with visual displays, permitting natural information rich environments. 	and optimizing visually displayed information algorithms for enhancing input to the visual ocessing, and solid-state display technologies in n-centered command and control symbology l situation understanding of complex	4.451	4.693	4.608
 (U) In FY 2007: Evaluated and improved algorithms to electronically enl state imagers. Improved methods to depict command and control and intuitive, easy-to-understand ways. Evaluated the methods using real environments 	hance vision when using head-mounted solid I other complex types of information in listic simulations of the targeted combat			
 (U) In FY 2008: Down-select and implement image-enhancing algorithm performance, and real-time tactical use. Develop a laboratory-grade to develop and evaluate new and innovative ways to visualize and int visually rich environments. Evaluate display symbologies and mecha Operations Center environments. 	ns that are optimized for speed, visual est bed usable to perform field tests. Continue eract with large amounts of information in anizations in simulated Air and Space			
(U) In FY 2009: Perform multispectral, real-time field evaluations of disponent 7404	play algorithm sets that have been optimized for R-1 Line Item No. 10			

Exhibit R-2	February	y 2008			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	ITLE PROJECT NUMBE n Effectiveness 7184 Decision ch Biosciences		ER AND TITLE n Effectiveness &	
(U) <u>B. Accomplishments/Planned Program (\$ in Mill</u> different tactical scenarios. Refine information port testing more intuitive visualizations and user interfa and improve total system effectiveness. Begin to de understanding in command centers.	<u>s</u>) al and interaction techniques to enhance decision-making by . Test these methods against current state-of-the-art to prove op visualization technologies that enhance cyberspace	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
 (U) (U) MAJOR THRUST: Develop advanced audio displa three-dimensional (3-D) audio, active noise reduction enhance performance and information processing in acoustic interfaces will integrate with warfighter equipation 	echnologies for human-to-human collaboration including and related technologies that mitigate effects of noise and e operational environment. In particular, these battlespace ment and amplify information delivery to the warfighter.	4.426	3.933	3.826	
(U) In FY 2007: Researched acoustic signal control to i environments by improving noise reduction technol information gathering for security forces. Began to propagation and ways to represent weather effects in technologies for remote collaboration. Explored ho control operations including 3-D audio symbology. communication breakdown.	rove human-to-human communications in operational es and use of acoustic signal processing to improve earch methods to incorporate weather effects on noise ynamic noise models. Developed auditory information aiding o improve audio symbology for streamlining command and gan to explore the human processes that lead to				
(U) In FY 2008: Explore the potential of acoustic aidin, communications by using acoustic signal processing research ways to adapt current noise models to enha operations. Continue to develop auditory informatic advances in communication theory for individuals. to communication breakdown. Explore improved ar interface to remote sensing.	uring urban operations to improve machine-to-human improve security forces' information gathering. Begin to e decision-making and acoustic detectability during offensive aiding technologies for remote collaboration, by exploiting ntinue to explore the individual and group processes that lead tory sensing to create virtual auditory reality for human				
 (U) In FY 2009: Develop acoustic aiding for urban ope ultrasonic and laser technology advances to improve methods and develop models to predict acoustic det operations. Continue to develop auditory information advances in communication theory for individuals. to communication breakdown. Improve auditory se interface to remote sensing, emphasizing its applica 	ons to improve machine-to-human communications by using curity forces' information gathering. Continue to explore ability under dynamic conditions for improved offensive aiding technologies for remote collaboration by exploiting ntinue to explore the individual and group processes that lead ng technology to create virtual auditory reality for human in to security forces.				
Proiect 7184	R-1 Line Item No. 10		Exhibit P-23		

	Exhibit R-2a, RDT&E Project Ju	DA	DATE February 2008		
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NU 7184 Decis Bioscienc	JMBER AND TITLE sion Effectiven es	ess &
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) MAJOR THRUST: Develop integrated human-centered Information/Cyber Oper Surveillance, and Reconnaissance (ISR) technologies to provide quicker and mor enhanced decision-making capabilities, more effective training procedures, and in	rations and Intelligence, e intuitive access to information, nproved tools for Information	<u>FY 2007</u> 11.545	<u>FY 2008</u> 9.091	<u>FY 2009</u> 12.056
(U)	Operations (IO)/ISR/Cyber operators' use in performing their respective missions In FY 2007: Conducted research and implementation of models for IO and ISR. system interfaces for additional Measurement and Signatures Intelligence (MASI spectral area. Developed tools and models for assessing the effectiveness of influ development of proof-of-concept technologies to specify, measure, and model ke developed counter-Improvised Explosive Device (IED) concepts/devices	Developed conceptual human NT) capabilities, specifically in the nence operations. Completed y parameters. Researched and			
(U)	In FY 2008: Validate conceptual human-system interfaces for additional MASIN validate tools and models for assessing the effectiveness of influence operations. development of tools and capabilities for Influence Operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and counter-Influe development of tools and models for assessing the effectiveness of influence operations and	T capabilities. Develop and Continue research and ence Operations. Continue rations. Continue research and adversarial behavior, both			
(U)	In FY 2009: Continue development and validation of advanced IO/Influence Opt techniques to enable increased offensive and defensive combat capabilities which threats. Validate and complete IO/Influence Operations models and simulation c prototype of advanced speech-to-speech translation tool. Continue development adversarial behavior, both individually and in group, with application in the psycl Investigate methods to enhance human ability to uncover concealed information. training for ISR team applications with emphasis on distributed operations.	erations research tools and training a counter asymmetric adversarial apabilities. Develop and validate of capability to anticipate hological operations domain. Develop collaborative tools and			
(U) (U)	MAJOR THRUST: Develop human injury criteria and protective system technol injury and disability causing threats to military personnel. Develop technologies safety of all airmen during military operations, such as flight, ground patrols, cras	ogies to provide sanctuary from to ensure accommodation and shes, emergency escape, extended	5.807	4.457	4.698
(U)	In FY 2007: Developed injury criterion for multi-axial dynamic neck loading and demographics. Determined the effects and interrelationships between equipment anthropometry, physical capability, cognitive capability, and increased equipmen Using risk-based analysis, identified primary musculoskeletal disability causes ar	d standards for gender and fit, workload, marginal t loads on pilot crew performance. nd began addressing equipment,			
Proj	ject 7184 R-1 Li	ne Item No. 10 ge-12 of 22 124		Exhibit R-2a ((PE 0602202F)

	Exhibit R-2a, RDT&E Project Justi	DA	DATE February 2008		
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NU 7184 Decis Bioscienc	IMBER AND TITLE sion Effectiven es	ess &
(U)	B. Accomplishments/Planned Program (\$ in Millions) procedure, or physical training improvements. Developed initial data mining and ana biomechanics, safety, and medical information systems.	lysis tools for searching across	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Conduct focused injury surveillance studies on specific career fields and that have high rates of injury and disability. Based on these studies, begin developing musculoskeletal disabilities and injuries due to personal equipment and workstation d and training improvements to reduce high training attrition due to injury, especially for training. Expand initial biomechanics collaborative information system to coordinate collections and analysis capabilities.	assignments to identify those technologies to reduce esigns. Develop procedures ocused on battlefield airmen DoD biomechanics data			
(U)	In FY 2009: Optimize equipment technologies, refine procedures, and improve traini most common AF job-related injuries and disabilities. Extend these improvements to also to optimize human performance. Develop workstation design criteria to maximiz minimize fatigue, based on interrelationships between equipment fit, workload, anthro and cognitive capability. Use biomechanics collaborative information technologies to protect forces against threats in hostile environments.	ng processes to address the not only prevent injuries but ze operator performance and opometry, physical capability, o collect and analyze data to			
(U) (U)	MAJOR THRUST: Quantify and model operator performance in stressful environme mitigate the effects of operational stressors on cognitive function, safety, and mission solutions to enhance human performance and ensure combat effectiveness in AF oper	nts and develop technologies to effectiveness. Develop ations.	1.563	1.991	1.066
(U)	In FY 2007: Developed concepts to reduce effects of heavy flight helmets in the high validation and transition of high-G cognitive model for simulation-based acquisition. technologies to augment cognition and enhance operator performance.	-G environment. Completed Explored biobehavioral			
(U)	In FY 2008: Continue behavioral research to characterize human performance and m during demanding military operations. Develop real-time biobehavioral performance evaluate cognitive readiness and decision making in command and control application mission rehearsal. Explore emerging cognitive disruption technologies and potential	itigate cognitive degradation monitoring technology to as, tactical operations, and countermeasures.			
(U)	In FY 2009: Continue behavioral neuroscience research to characterize and mitigate l during demanding military operations. Refine real-time biobehavioral performance m develop operational employment concepts. Continue to investigate cognitive disrupti countermeasures.	human cognitive degradation nonitoring technology and on technologies and potential			
(U)					
(U)	MAJOR THRUST: Develop, demonstrate, and apply experimental models for predic	ting toxicological compromises	2.093	1.769	1.941
Proj	ect 7184 R-1 Line Ite Page-13	m No. 10 3 of 22		Exhibit R-2a	(PE 0602202F)

	Exhibit R-2a, RDT&E Project	DA	TE February	2008	
BUDG 02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NU 7184 Decis Bioscienc	UMBER AND TITLE sion Effectiven es	ess &
(U)	B. Accomplishments/Planned Program (\$ in Millions) in human mission performance and create in-house and field methods to assure toxic hazards and exposures in Joint operational environments. Using integrate predictive algorithms to describe functional cellular dynamics and engineering and performance of AF systems. Improve commander decision-making ability protection requirements.	protection of AF personnel from d biological approaches, create constructs for advancing detection to properly balance mission and force	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Applied procedures and computer simulation models to predict ef nanomaterial exposure on Air Expeditionary Forces and improved the protectio environments. Further developed and demonstrated algorithms to describe the potential for improved logic and sensor capability for Air Force systems.	fects of toxic compound and n of AF personnel in operational function of cellular dynamics with the			
(U)	In FY 2008: Develop and apply procedures and computer simulation models to material, toxic compound, and nanomaterial exposure on Joint Service and Air computer modeling and integrated biological approaches to understand function explore and create integrated new sensor and material constructs for AF applica	predict effects of large volume Expeditionary Forces. Using nal cellular dynamics and engineering, ations.			
(U)	In FY 2009: Further develop procedures and computer simulation models to pr nanomaterial exposure on Joint Service and Air Expeditionary Forces. Using c biology approaches to understand functional cellular dynamics and engineering integrated new sensor and material constructs for AF applications.	edict effects of toxic compound and omputer modeling and systems , continue to explore and create			
(U)					
(U)	MAJOR THRUST: Develop biotechnologies to identify warfighter exposures to in illness or a reduction in mission performance, thus greatly improving force p mission success.	to hazardous agents before they result rotection and the probability of	5.931	4.072	3.836
(U)	In FY 2007: Conducted genomic, proteomic, and metabolite studies to identify fluids of the deployed airmen exposed to hazardous agents. Completed kidney biomarker patterns for early detection of the effects of unknown hazardous agents.	target-organ biomarkers in body and assessed liver organ response nts on AF personnel.			
(U)	In FY 2008: Continue to conduct genomic, proteomic, and metabolite studies t and their assessment methods for hazardous agent exposure. Complete validati biomarkers and down-select liver organ response biomarker patterns for early d hazardous agents on AE personnel	o identify target-organ biomarkers on panel for selected kidney etection of the effects of unknown			
(U)	In FY 2009: Complete genomic, proteomic, and metabolite studies to identify a biomarkers of hazardous agent exposure in deployed airmen. Extend program and brain biomarkers of degradation from hazardous agent exposure in AF pers	and validate kidney and liver to investigate connective tissue, lung, onnel.			
Proj	ect 7184 R-1	Line Item No. 10 Page-14 of 22		Exhibit R-2a	(PE 0602202F)

Exhibit R-2a, RDT&E I	Project Justification	DATE February 2008			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITL 7184 Decision Effective Biosciences		iess &	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
 MAJOR THRUST: Develop logistics readiness technology options large-scale advanced technology development programs. These tech logistics resources for Air Expeditionary Force operations. Note: In Air Force priorities. 	and perform feasibility studies to support hnologies will lead to more efficient utilization of n FY 2009, this effort is reduced due to higher	2.236	2.775	1.332	
(U) In FY 2007: Investigated and applied new techniques for future log presentation and for task/job aiding and training. Completed work of promote effects-based logistics using a net-centric environment. Ide defined emergency response logistics requirements.	istics and maintenance technical data on defining sense-respond capabilities which will entified technology gaps to meet previously				
(U) In FY 2008: Investigate methods for performance measurement and and versatile media formats in packaging and delivering job/task aid Investigate integration mechanisms for these human-centered techno monitoring technologies to promote more accurate system repair pro- tection of the system repair pro- monitoring technologies to promote more accurate system repair pro- tection of the system repair pro- monitoring technologies to promote more accurate system repair pro- tection of the system repair pro- section of the system repair pro- sec	l evaluation of augmented reality, virtual reality, ling and training solutions for maintenance work. ologies with on-board diagnostic/health presses at the point of maintenance.				
 (U) In FY 2009: Further explore and apply integrated, multifunction job field tests. Investigate the usefulness of collaboration support for tro problems. Explore the hardware, software, and packaging issues for devices for maintenance work. 	b aiding concepts in laboratory and controlled publeshooting and complex field repair r combined job aid and on-the-job training				
(U)		0.001	0.000	0.000	
 (U) CONGRESSIONAL ADD: Networked Warfighter Decision Suppo (U) In FY 2007: Conducted Congressionally-directed effort for Networ (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 	rt. ked Warfighter Decision Support.	0.981	0.000	0.000	
		0.092	0.000	0.000	
 (U) In FY 2007: Conducted Congressionally-directed effort for Bio Me (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 	dical DNA Program.	0.982	0.000	0.000	
 (U) (U) CONGRESSIONAL ADD: Eyewear Display for Battlefield Operat (U) In FY 2007: Conducted Congressionally-directed effort for Eyewea (U) In FY 2008: Not Applicable. 	ions. r Display for Battlefield Operations.	0.981	0.000	0.000	
Project 7184	R-1 Line Item No. 10 Page-15 of 22		Exhibit R-2a	(PE 0602202F)	

	Exhibit R-2a, RDT&E Project Just	ification	DA	DATE February 2008		
BUD(02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NI 7184 Deci Bioscienc	JMBER AND TITLE sion Effectiven es	iess &	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Not Applicable.					
(U)	CONCRESSIONAL ADD. Dattlefield Automatic Life Status Maritan		1 279	0.000	0.000	
(U)	Lin EX 2007: Conducted Congressionally directed affort for Battlafield Automatic Li	fo Status Monitor	1.278	0.000	0.000	
(0)	In FY 2007. Conducted Congressionary-directed effort for Batterield Automatic Li	Te Status Monitor.				
(0)	In FY 2009: Not Applicable					
(U)						
(U)	CONGRESSIONAL ADD: Miniature Tri-Axial Accelerometer.		0.981	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Miniature Tri-Axial Acc	elerometer.				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Unmasking Deception and Denial.		0.981	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Unmasking Deception as	nd Denial.				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Imaging Tools for Human Performance Enhancement and	nd Diagnostics.	0.000	1.590	0.000	
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Conduct Congressionally-directed effort for Imaging Tools for Human Diagnostics.	Performance Enhancement and				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Warfighter Pocket XP-Next Gen.		0.000	1.590	0.000	
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Conduct Congressionally-directed effort for Warfighter Pocket XP-Nex	tt Gen.				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	Total Cost		63.435	51.468	49.496	
Proi	ect 7184 R-1 Line It Page-1	em No. 10 6 of 22		Exhibit R-2a	(PE 0602202F)	
	12	28			· · · · · ·	

BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research PROJECT NUMBER AND TITLE 03 Applied Research 1784 Decision Effectiveness & Biosciences (U) C.Other Program Funding Summary (\$ in Millions) EY 2005 EY 2007 EY 2008 EY 2017 EY 2009 EY 2018 Extimate Estimate Estimate Estimate Estimate Estimate Estimate Complete Complete Dynamics. Estimate Command, Counto, and Communications. Complete (U) PE 0602301F, Crownand, Counto, and Communications. Estimate (U) PE 0603331F, Crew Systems and Personnel Protection Technology. PE 0603345F, Flight Vehicle Technology. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0604706F, Life Support Systems. Systems. (U) D.Cocquistion Strategr Not Applicable. Not Applicable.			Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008
 (U) C. Other Program Funding Summary (5 in Millions) <u>EY 2007</u> <u>EY 2008</u> <u>EY 2009</u> <u>EY 2010</u> <u>EY 2011</u> <u>EY 2012</u> <u>EY 2013</u> <u>Cost to</u> <u>Total CY</u> <u>Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete</u> <u>Total CY</u> (U) Related Activities: (U) PE 0602201F, Aerospace Elight Dynamics. (U) PE 0602702F, Command, Control, and Communications. (U) PE 0602702F, Command, Control, and Communications. (U) PE 0602702F, Flight Vehicle Technology. (U) PE 0602732F, Flight Vehicle Technology. (U) PE 0604732F, Flight Vehicle Technology. (U) D. Acquisition Strategy Not Applicable. (U) D. Acquisition Strategy Not Applicable. (E) The Item No. 10 	BUD 02 /	GET ACTIVITY Applied Research		PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research			PROJECT NUMBER AND TITLE 7184 Decision Effectiveness & Biosciences			
PY 2002 PY 2008 PY 2010 PY 2011 PY 2012 PY 2015 Cost for Total Ca Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Ca (U) PE 0602201F, Acrospace Flight Dynamics. Dynamics. F1 0002204F, Acrospace Sensors. (U) PE 0602202F, Command, Communications. Ontrol, and Communications. De 0602305F, Flight Vehicle Technology. F0 6003205F, Flight Vehicle Technology. Technology. De 06023245F, Flight Vehicle Technology. Technology. De 06023245F, Flight Vehicle Technology. Technology. (U) PE 0604706F, Life Support Systems. Systems. (U) PE 0604706F, Life Support Systems. (U) PE 0604706F, Life Support Systems. (U) De 0604706F, Life Support Systems. (U) D. Acquisition Strategy Not Applicable.	(U)	C. Other Program Funding Sum	mary (\$ in Millio	ons)	EV 2000	EX 2010	EV 2011	EV 2012	EX 2012	
 (U) Related Activities: (U) PE 0602201F, Acrospace Flight Dynamics. (U) PE 0602204F, Acrospace Sensors. (U) PE 0602702F, Command, Control, and Communications. (U) PE 0603203F, Flight Vehicle Technology. (U) PE 0603231F, Crew Systems and Personnel Protection Technology. (U) PE 0603245F, Flight Vehicle Technology Integration. (U) PE 0604706F, Life Support Systems. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and climinate duplication. (U) D. Acquisition Strategy Not Applicable. 			<u>FY 2007</u> Actual	<u>FY 2008</u> 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	Const to Complete <u>Total Cost</u>
R-1 Line Item No. 10	(U) (U) (U) (U) (U) (U) (U) (U) (U)	Related Activities: PE 0602201F, Aerospace Flight Dynamics. PE 0602204F, Aerospace Sensors. PE 0602702F, Command, Control, and Communications. PE 0603205F, Flight Vehicle Technology. PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0603245F, Flight Vehicle Technology Integration. PE 0604706F, Life Support Systems. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.								
Project 7184 Page-17 of 22 Evbibit D 20 /DE 060220	Dro	iect 7184			R-1 Line	e Item No. 10				Evhibit R-22 (PE 0602202E)
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	Exhibit R-2a, RDT&E Project Justification										
BUDGET ACTIVITY 02 Applied Researc	ch			P 0 A	E NUMBER AND 602202F Hun Applied Resea	TITLE nan Effective arch	eness	PROJECT NUME	BER AND TITLE	ection	
Cos	t (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
7757 Bioeffects an	nd Protection	25.067	23.684	18.993	19.488	18.230	18.993	19.088	Continuing	TBD	
Quantity of I	RD1&E Articles		0	0	0	0	0	0			
The project asses provides tailored systems through safety, risk assess	ses the bioeffects of direc /agile human performance technology developments sment, mission planning, o	ted energy for fe e optimization te that ameliorate/ countermeasures	orce protection chnologies to o counter/exploi s, personnel pro	a, special operation confront asymmetry t the biological otection, and co	tions, military of netric threats. ' l effects of oper punterproliferat	operations othe The project ena rational stresson tion research, te	r than war, and ables the safe of rs and other th echnology dev	d peacekeeping a operational use of reats. It address elopment, and v	applications; ar of AF aerospace ses areas such a ralidation.	nd e s	
 (U) <u>B. Accomplisht</u> (U) MAJOR THRU exploitation of 1 	ments/Planned Program ST: Conduct laboratory e aser technology while pro	(\$ in Millions) experiments and	field research	on laser bioeffe	ects, enabling n	nilitary	<u>F</u> Y	<u>¥ 2007</u> 6.423	<u>FY 2008</u> 6.314	<u>FY 2009</u> 6.678	
(U) In FY 2007: De laser eye protect system. Develo probabilistic rish for laser scatter	eveloped technologies to i tion in an integrated forma ped robust modeling and k assessment tools. Devel for high energy laser appl	mprove combat at. Evaluated in simulation prog loped first mode lications.	vision, includi pacts of multi cams and first a ls of dynamic	ng human facto wavelength las approximations bidirectional re	ors methodolog ers upon the hu s of near real-tin flectivity distri	ies. Provided Iman visual me bution functior	1				
(U) In FY 2008: Int laser eye damag for multiple way lasers upon criti	tegrate dynamic bidirection te for collateral hazard associated associated as the second velengths to validate DoD cal aircrew and ground for	onal reflectivity of essments of type , national, and in pree missions.	listribution ma cal laser system nternational sat	thematical moons. Expand las fety standards.	dels into diagno ser damage thre Evaluate impa	ostic tools of eshold database ct of visible	2				
(U) In FY 2009: Per reflectivity distriction collateral hazard demonstrations. target bioeffects	erform field and laborator ibution calculations for us assessment software mod Initiate experiments for t	y experiments to se as high energ del into airborne future high energ	verify and va v laser collater laser platform gy laser weapo	lidate optical p al hazard asses n performing hi n systems to pr	hysics model o sment tool. Int gh energy laser redict, evaluate	f bidirectional egrate system , and explore					
 (U) (U) MAJOR THRU enable the safe of 	ST: Conduct electromage	netic (EM) field	bioeffects labo	bratory experimination target	nents and field r	research to		6.225	6.050	6.542	
(U) In FY 2007: Fu effectiveness as	nile identifying counterme rther refined methods to e sessments of emerging dir	easures to EM has evaluate the bioe rected energy we	ffects of direct apons. Extend	ted energy wea ded laboratory	pons and suppo and field assess	ort safety and sment					
Project 7757				R-1 Line Iten Page-18	n No. 10 of 22				Exhibit R-2a (I	PE 0602202F)	

Exhibit R-2a, RDT&E Project	Justification	D/	February	/ 2008
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT N 7757 Bioe	UMBER AND TITLE	ection
(U) <u>B. Accomplishments/Planned Program (\$ in Millions</u>) techniques into the terahertz range. Enhanced modeling and simulation tools t and performance impact of high frequency EM systems. Evaluated human hea peak power EM systems using biotechnology. Conducted research to support standards.	o evaluate the human health, behavior, alth in response to high power and high scientifically-based human exposure	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2008: Explore tissue interactions from terahertz frequencies to evaluate vulnerabilities. Improve EM tissue models to include terahertz and high powe support fielding and effectiveness of radio frequency (RF) directed energy wea	safe exposure levels and tissue r EM effects. Continue research to apon systems.			
(U) In FY 2009: Conduct experiments to refine and eliminate gaps in RF exposure band, high peak power RF systems, and terahertz frequency ranges. Integrate bioeffects, and target effects computer models based on RF studies in microwa and terahertz sources. Investigate RF bioeffects as a foundation for future RF	e standards for microwave, ultra-wide and improve human behavior, ave, ultra-wide band, high peak power, weapons.			
 (U) (U) MAJOR THRUST: Develop biotechnologies to accurately and affordably sup neutralization, and assessment of threat agents. Perform counterproliferation r continue in the most efficient manner. 	port the detection, identification, esearch to enable air operations to	5.329	4.006	3.731
(U) In FY 2007: Developed technologies to identify the production source of threa methods to assess the viability of threat agents after active countermeasures ha counterproliferation research to better predict and further minimize collateral of	at agents. Developed and validated we been employed. Refined lamage.			
(U) In FY 2008: Continue to develop and validate methods to assess the viability active countermeasures have been employed. Begin to develop technologies the biological warfare agents behind walls and inside of containers. Characterize interactions with directed energy to enhance agent neutralization capabilities.	and activity of threat agents after hat will enable the AF to locate organic semiconductor material			
(U) In FY 2009: Refine viability assessment technologies and develop models tha minimize collateral damage from counterforce weapon detonations. Continue taggant technologies that will locate biological warfare agents behind walls an counterproliferation technologies capable of effectively neutralizing geneticall	t predict plume distribution patterns to to develop advanced biological d in containers. Investigate y modified biological threat agents.			
 (U) (U) MAJOR THRUST: Develop novel technology solutions integrating behaviora nutritional strategies, and personal protective technologies to enable human pe stressor environments. Results will optimize operational execution through in attrition/lost training days, and faster post-mission recovery. 	Il psychology, metabolomic research, rformance optimization in multiple creased human effectiveness, reduced	1.544	1.749	2.042
Project 7757	Line Item No. 10 Page-19 of 22		Exhibit R-2a	(PE 0602202F)

	Exhibit R-2a, RDT&E Project Just	ification	DATE February 2008			
BUD(02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT N 7757 Bioe	UMBER AND TITLE	tection	
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2007: Investigated individual differences in human performance variability ar optimizing interventions. Extended individual performance research to quantify effet task novelty, and experience on collaborative team performance in a cognitively dem Developed methodologies to tailor behavioral and physiological regimens to achieve performance capabilities.	nd response to performance cts of workload distribution, aanding environment. flexible task-based human	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Continue to develop methodologies to tailor behavioral and physiologic revolutionary concepts in metabolomics/human performance technologies with exist. Continue research to quantify effects of workload distribution, task novelty, and experiment a cognitively demanding environment.	cal regimens and integrate ing training/operations. erience on team performance in				
(U)	In FY 2009: Continue development and assess benefit of tailored/agile human performance models to incorrect the threats. Expand biobehavioral performance models to incorrect human performance vulnerability.	rmance optimization regimens porate individual differences in				
(U)	MAJOR THRUST: Develop technologies and procedures to counter physiological e improve pilot performance under high, rapid-onset gravitational forces, and deliver o airman safety during global attack, global mobility, and special operations missions. 2007 due to higher AF priorities.	ffect of high altitude flight, oxygen. Research will enhance Note: Effort terminated in FY	0.343	0.000	0.000	
(U)	In FY 2007: Evaluated ability of candidate integrated aircrew ensemble technology life support equipment deficiencies. Assessed oxygen generation systems technology environment.	components to address identified y effectiveness in a chemical				
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.					
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Solid Electrolyte Oxygen Separator (SEOS). In FY 2007: Conducted Congressionally-directed effort for SEOS. In FY 2008: Conduct Congressionally-directed effort for SEOS. In FY 2009: Not Applicable.		4.221	3.180	0.000	
(U) (U) (U)	CONGRESSIONAL ADD: Warfighter Sustainability: Maximizing Human Perform In FY 2007: Conducted Congressionally-directed effort for Warfighter Sustainability Performance.	nance. y: Maximizing Human	0.982	0.000	0.000	
Pro	R-1 Line It ect 7757 Page-2	em No. 10 0 of 22 32		Exhibit R-2a	(PE 0602202F)	

		Exhibit R-	2a, RDT&E	Project Jus	tification			Ľ	February	/ 2008	
BUD(02 A	GET ACTIVITY pplied Research				PE NUMBER AND TITLE PROJE 0602202F Human Effectiveness 7757 Applied Research				ECT NUMBER AND TITLE Bioeffects and Protection		
(U) (U) (U)	B. Accomplishments/Planned Pro In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ogram (\$ in Mil	<u>lions)</u>				<u>F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Ubiqu In FY 2007: Not Applicable. In FY 2008: Conduct Congression In FY 2009: Not Applicable.	itous RFID Cher	m/Bio Detectior ort for Ubiquito	ı. us RFID Chem/I	Bio Detection.			0.000	0.795	0.000	
(U) (U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Mode In FY 2007: Not Applicable. In FY 2008: Conduct Congression In FY 2009: Not Applicable.	ling of Aggregate	es of Individual ort for MAICE.	s and Crowd En	vironments (MA	JCE).		0.000	1.590	0.000	
(U) (U)	Total Cost							25.067	23.684	18.993	
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602720A, Environmental Quality Technology. PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0604617F, Agile Combat Support. PE 0604706F, Life Support Systems. This project has been coordinated through the Pediance 21 process to	<u>nary (\$ in Millic FY 2007</u> <u>Actual</u>	<u>Pry 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 20</u> <u>Estim</u>	<u>13 Cost to</u> ate <u>Complete</u>	<u>Total Cost</u>	
Pro	harmonize efforts and eliminate			R-1 Line Page	Item No. 10 -21 of 22 133				Exhibit R-2a	(PE 0602202F)	

Exhibit R-2a, RDT&E	Project Justification	DATE February 2008
UDGET ACTIVITY 2 Applied Research	PE NUMBER AND TITLE 0602202F Human Effectiveness Applied Research	PROJECT NUMBER AND TITLE 7757 Bioeffects and Protection
U) <u>C. Other Program Funding Summary (\$ in Millions)</u> duplication.		
U) <u>D. Acquisition Strategy</u> Not Applicable.		
Project 7757	R-1 Line Item No. 10 Page-22 of 22	Exhibit R-2a (PE 0602202

PE NUMBER: 0602203F PE TITLE: Aerospace Propulsion

	Exhit	vit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDGET 02 Apr	UDGET ACTIVITY PE NUMBER AND TITLE 2 Applied Research 0602203F Aerospace Propulsion									
	Cost (\$ in Millions)	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	Complete	1'
	Total Program Element (PE) Cost	220.143	217.172	218.049	202.638	178.565	178.795	183.615	Continuing	TBD
3012	Advanced Propulsion Technology	29.077	21.844	18.055	17.057	22.924	19.949	20.446	Continuing	TBD
3048	Fuels and Lubrication	24.022	30.752	25.497	24.963	19.197	19.981	20.697	Continuing	TBD
3066	Turbine Engine Technology	48.345	56.247	87.771	71.314	49.947	47.101	49.024	Continuing	TBD
3145	Aerospace Power Technology	43.560	44.201	29.280	29.588	29.798	31.534	31.889	Continuing	TBD
33SP	Space Rocket Component Tech	56.623	53.477	48.258	49.014	49.188	48.468	49.486	0.000	0.000
4847	Rocket Propulsion Technology	18.516	10.651	9.188	10.702	7.511	11.762	12.073	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 2007 Congressionally-directed High Energy Laser for Detection Inspection and Non-Destructive Testing in the amount of \$2.7 million were moved to the Defense Advanced Research Projects Agency, from PE 0602203F, Aerospace Propulsion, for execution. Funds for the FY 2007 and 2008 Congressionally-directed Center for Solar Electricity and Hydrogen were moved from PE 0602203F to PE 0602601F, Space Technology, for execution.

(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. 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. Fuels and Lubrication evaluates fuels, lubricants, and combustion concepts and technologies for new and existing engines, evaluates alternative fuels and additives, and directly supports the Versatile Affordable Advanced Turbine Engine (VAATE) program. Turbine Engine Technology develops enabling capabilities to enhance performance and affordability of existing weapon systems to include efforts that are part of the VAATE program. Aerospace Power Technology develops electrical power and thermal management technologies for space access, space maneuver, and missiles. Rocket Propulsion Technology develops advances in rocket technologies for space access, space maneuver, and missiles. Rocket Propulsion Technology develops advances in rocket technologies for widely varying mission needs. Note: In FY 2008, Congress added \$3.5 million for Active Combustion Control System for Military Aircraft; \$0.8 million for Advanced Fuel Cell Based Power Systems for Small UAVs; \$1.6 million for a Advanced Vehicle and Propulsions. Space Applications; \$6.0 million for High Energy Superior Lithium Ion Battery Technology; \$2.4 million for an Integrated Propulsion for LOX/Methane Cooled Upper Stage Rocket Engine technology; \$1.4 million for THEMA - Thermal and

Exhibit R-2 (PE 0602203F)

	Exhibit R-2, RDT	&E Budget Item Justification	get Item Justification		
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Prop	ulsion		•
	Energy Management for Aerospace applications; \$1.6 mill Battery Controller technologies. This program is in Budge of evolutionary and revolutionary technologies.	lion for VDVP for UAV/UCAV Aircraft Engines; and \$1.2 et Activity 2, Applied Research, since it develops and deterr	million for WAS nines the technic	SH Oxygen Sensor and C al feasibility and militar	Cell Level y utility
(U)	B. Program Change Summary (\$ in Millions)				
			<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget		218.657	179.161	217.394
(U)	Current PBR/President's Budget		220.143	217.172	218.049
(U)	Total Adjustments		1.486	38.011	
(U)	Congressional Program Reductions			1 200	
	Congressional Rescissions			-1.389	
	Congressional Increases		4.004	37.800	
	Reprogrammings		4.804	1.600	
	SBIR/STIR Transfer		-3.318		
	(U) Under Development.				
		R-1 Line Item No. 11 Page-2 of 35		Exhibit I	R-2 (PE 0602203F)

	Ext	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DAT	[⊤] February	2008	
BUDGI 02 A ¢	ET ACTIVITY oplied Research			F	PE NUMBER AND TITLE PROJECT 0602203F Aerospace Propulsion 3012 A Techn			PROJECT NU 3012 Advar Technology	ECT NUMBER AND TITLE Advanced Propulsion nology		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
3012	Advanced Propulsion Technology	29.077	21.844	18.055	17.057	22.924	19.949	20.44	6 Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0		0	0		0	L .	
Techn develo (U) <u>4</u> T T F	ology, absorbed Combined Cycle Engine opments. A. Mission Description and Budget Item This project develops combined/advanced revolutionary propulsion options for the Ai orimary focus is on hydrocarbon-fueled en concept demonstrations of critical compon-	(CCE) efforts fr <u>Justification</u> cycle airbreathi ir Force. These gines capable of ents; advanced	om Project 33 ng high-speed new engine tea operating ove component dev	SP, Space Rock (up to Mach 4) chnologies will er a broad range velopment; and	ket Component) and hypersonic l enable future h e of flight Mach l ground-based c	Technology, in c (Mach 4 to 8+ high-speed/hype numbers. Ef lemonstrations	-) propulsion to ersonic weapo forts include n	e effectively n echnologies to ns and aircraf nodeling, sim	nanage cooperativ o provide t concepts. The ulations, and prod	ve CCE of of	
(TD	B. Accomplishments/Planned Program	(\$ in Millions)					FY	2007	FY 2008	FY 2009	
(U)	MAJOR THRUST: Develop advanced fu enable the broad application of hypersonic demo nears completion in FY 2008.	iel-cooled scran cs to meet futur	ijet engine tech e warfighter ne	nnologies to su eeds. Note: Co	pport flight den omponent work	nonstration and supporting	1	11.649	1.092	3.069	
(U) (U)	In FY 2007: Developed and demonstrated controller. Performed trajectory optimiza generator/heat exchanger system, barbota throat or air throttle. Verified operation of characterization coupled with fuel control flight weight, fixed geometry inlet scramj In FY 2008: Continue development and c engine control logic. Continue performin coromist start including and constrated	a flight weight e tion for flight te ge fuel injectior of engine control l logic, to ensure jet engine with i demonstration o ig trajectory opti-	st. Evaluated a, plasma igniti techniques, ba stable scramje mproved opera f scramjet fligh mization for fl	options for scru on, and silane ased on rapid s et operation. C ability to reduce the weight engine light test. Contra-	amjet start, incli injection with a hock train ident Completed groun e flight test risk ne components a tinue evaluating	a closed loop uding gas mechanical ification and nd test of a und advanced options for					
(U)	scramjet start, including gas generator/hea injection with a mechanical throat or air th Continue verification of operation of engi characterization coupled with fuel control In FY 2009: Continue development and c control logic. Continue performing trajec start, including gas generator/heat exchan- with a mechanical throat or air throttle. C	at exchanger sys hrottle. Initiate ine control techr l logic, to ensure demonstration o ctory optimization ger system, barl Complete ground	tem, barbotage design and test iques, based o stable scramje f flight weight on for flight test potage fuel inje testing of adv	e fuel injection ting of advance n rapid shock t et operation. engine compo st. Continue ev ection, plasma ranced scramje	a, plasma ignitio ed scramjet start train identificati nents and advar valuating option ignition, and sil t start technique	n, and silane t techniques. on and aced engine s for scramjet ane injection as. Complete					
Proie	ct 3012			R-1 Line Iter Page-3	m No. 11 of 35				Exhibit R-2a (PE 0602203F)	
				137	7					/	

	Exhibit R-2a, RDT&E Project Jus	DA	February	/ 2008		
BUDG 02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT N 3012 Adv Technolo	UMBER AND TITLE anced Propulsi gy	on	
(U)	B. Accomplishments/Planned Program (\$ in Millions) development of scramjet engine control logic for flight test engines. Continue veri control techniques, based on rapid shock train identification and characterization co ensure stable scramjet operation.	fication of operation of engine oupled with fuel control logic, to	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)						
(U)	MAJOR THRUST: Conduct assessments, technology design trades, and simulation engines (CCEs) and advanced cycle airbreathing hypersonic propulsion technologic manned and unmanned air and space vehicle concepts. CCEs require the developm components to integrate scramjets with high speed turbines and/or rocket engines for broad range of Mach numbers. Note: In FY 2009, efforts in this thrust were reduct priorities.	ns to integrate combined cycle es into future missiles and into nent and demonstration of for efficient propulsion over a red due to higher Air Force	2.184	1.966	0.181	
(U)	In FY 2007: Conducted trade studies to determine military payoff and establish co Defined component and engine performance objectives to enable development of a demonstrators jointly with NASA and DARPA. Developed advanced components rocket-based CCEs. Fabricated and initiated test of advanced inlets for turbine-base from Mach 0 to Mach 8.	omponent technology goals. Iffordable hypersonic flight for turbine-based and sed CCEs capable of operating				
(U)	In FY 2008: Continue trade studies to determine military payoff and establish com Continue defining component and engine performance objectives to enable develop flight demonstrators jointly with NASA and DARPA. Continue development of ac turbine-based and rocket-based CCEs. Complete testing of advanced inlets for turb operating from Mach 0 to Mach 8. Design an advanced nozzle for turbine-based a	nponent technology goals. pment of affordable hypersonic dvanced components for bine-based CCEs capable of nd rocket-based CCEs.				
(U)	In FY 2009: Continue CCE trade studies to determine military payoff and establish Continue defining component and engine performance objectives to enable develop flight demonstrators. Continue development of advanced components for turbine-	h component technology goals. pment of affordable hypersonic based and rocket-based CCEs.				
(U)						
(U)	MAJOR THRUST: Develop robust hydrocarbon fueled scramjet engine component performance, operability, durability, and scalability for future missiles. Note: Star towards much larger hot section testing and voluminous test data will be required t phenomena to the original baseline configuration to provide the knowledge to scale larger applications potentially up to space launch. In FY 2009, efforts in this thrus Force priorities.	nts and technologies to improve rting in FY 2008, efforts shift o correlate the combustion scaling e the scramjet configuration to t were revamped due to higher Air	10.436	18.786	14.805	
(U)	In FY 2007: Developed advanced engine components to improve scramjet operation	ng margin and to establish				
Proje	ect 3012 R-1 Line Pag	e Item No. 11 e-4 of 35		Exhibit R-2a	(PE 0602203F)	
	Exhibit R-2a, RDT&E Proje	DATE February 2008				
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BUDG 02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3012 Advanced Propulsion Technology			
(U)	B. Accomplishments/Planned Program (\$ in Millions) scramjet scaling laws for reusable applications. Developed variable geom take-over from Mach 4.5 to Mach 3.5 to provide robust options for CCEs, combustors for reusable applications with improved structural efficiency. durability engine concepts. Developed low internal drag flame stabilization components.	netry techniques to decrease scramjet Completed test of round scramjet Initiated development of improved on devices and flight test engine	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Continue development of advanced engine components to in establish scramjet scaling laws for reusable applications. Continue develo decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust scramjet combustors 5 to 10 times baseline size for reusable applications. Initiate development of improved durability engine concepts. Continue de stabilization devices and flight test engine components.	nprove scramjet operating margin and to opment of variable geometry techniques to options for CCEs. Complete test of with improved structural efficiency. evelopment of low internal drag flame				
(U)	In FY 2009: Continue development of advanced engine components to in establish scramjet scaling laws for reusable applications. Continue develo decrease scramjet take-over from Mach 4.5 to Mach 3.5 to provide robust of low internal drag flame stabilization devices and flight test engine com test facilities and test techniques to demonstrate large (20 to 100 times) size	nprove scramjet operating margin and to opment of variable geometry techniques to options for CCEs. Continue development ponents. Conduct assessment of ground ze scramjet engines.				
(U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced High Speed Propulsion Developm In FY 2007: Enhanced the nation's ability to test and analyze high speed p combined cycle engines. In FY 2008: Not Applicable.	ent. propusion systems such as scramjets and	0.981	0.000	0.000	
(U) (U) (U) (U)	CONGRESSIONAL ADD: X-51 Robust Scramjet Flight Research. In FY 2007: Investigated the integration of alternative high speed combin circular and rectangular scramjets) for potential flight demonstration unde In FY 2008: Not Applicable.	ned cycle engine configurations (such as er X-51 follow-on efforts.	3.827	0.000	0.000	
(U) (U)	In FY 2009: Not Applicable. Total Cost		29.077	21.844	18.055	
Proj	ect 3012	R-1 Line Item No. 11 Page-5 of 35		Exhibit R-2a	(PE 0602203F)	

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February 2008	
BUDGET AC 02 Applied	TIVITY d Research				PE NUMBER A 0602203F A	ND TITLE erospace Pro	pulsion	PROJECT NUMBER AND TITLE 3012 Advanced Propulsion Technology		
(U) <u>C. Ot</u> l	<u>her Program Funding Summ</u>	nary (\$ in Millio <u>FY 2007</u>	ons) <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) Relate (U) PE 060 Science (U) PE 060 Dynan (U) PE 060 Multi- (U) PE 060 Techn (U) PE 060 Techn (U) PE 060 Structu (U) PE 060 Propul Techn (U) PE 060 Weapo (U) PE 060 Veapo (U) PE 060 Army/ (JANN (U) Progra to/coo Army/ (JANN Comm (U) This p coordi Relian harmo duplic 	ed Activities: 01102F, Defense Research ces. 02201F, Aerospace Flight mics. 02500F, Disciplinary Space Tech. 02602F, Conventional ions. 02702E, Tactical 1000gy. 03211F, Aerospace ures. 03216F, Aerospace lsion and Power 100gy. 03601F, Conventional ons Technology. am is reported ordinated by the Joint /Navy/NASA/Air Force NAF) Executive nittee. project has been inated through the nee 21 process to onize efforts and eliminate eation.	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Project 3012	2			R-1 Line Page 1	ltem No. 11 -6 of 35 40				Exhibit R-2a (PE 0602203F)	

Exhibit R-2a, RDT	&E Project Justification	February 2008
BUDGET ACTIVITY 12 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3012 Advanced Propulsion Technology
U) <u>D. Acquisition Strategy</u> Not Applicable.		
	R-1 Line Item No. 11	

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDG 02 A	BET ACTIVITY pplied Research			P 0	E NUMBER AND	TITLE ospace Prop	ulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3048	Fuels and Lubrication	24.022	30.752	25.497	24.963	19.197	19.981	20.697	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Note: Cong Adva (U)	The funding in this project has been incre ressionally-directed High Energy Laser for nced Research Projects Agency, from PE 0 A. Mission Description and Budget Item	ased to provide Detection Insp 62203F, Aeros Justification	emphasis on c ection and Non pace Propulsion	omponent deve Destructive T n, for executior	elopment in sup esting in the an 1.	port of adaptiv nount of \$2.7 n	e cycle technol nillion are in th	logies. Funds f e process of be	or the FY 2007 ing moved to th	he Defense
	engines. This project also develops techno weight, fuel consumption, and cost of owne experimental areas of emphasis include fue fundamental combustion, and detonations. conditions. Advanced combustion concept technologies. This effort develops compon varying mission needs.	logies to increa ership. Applica Is and fuels log Fuels and lubr s must be cost- ent technology	se turbine engi tions include n istics, lubrican icants for these effective, dural for an adaptive	ne operational inissiles, aircrafts, bearings, ele engines must lole, and reduce e cycle engine a	reliability, dura it, sustained hig ectromagnetic r be thermally sta pollutant emiss architecture tha	bility, mission h-speed vehicle otor, oil-less en able, cost-effect sions. A portio t provides optin	flexibility, and es, and respons agine technolog tive, and opera n of this projec mized performa	l performance v ive space launc gy, optical diag te over a broad et supports adap ance/fuel efficie	while reducing h. Analytical a nostics, range of otive cycle ency for widely	and 7
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop low-cost add the flight envelope for manned and unmar an adaptive cycle engine architecture. De Increased funding in FY 2008 and out due technologies.	(\$ in Millions) ditive and fuel s nned aircraft. D sign, fabricate, to emphasis of	system approac betermine fuel of and test of key a component do	hes to improve cooling require thermal manage evelopment in s	fuel properties ments and spec gement technolo support of adap	and to expand ifications for ogies. Note: tive cycle	<u>FY</u>	2007 2.179	<u>FY 2008</u> 3.102	<u>FY 2009</u> 6.628
(U)	 In FY 2007: 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. Initiated effort to validate component performance models on aircraft thermal management simulator. Developed approaches to assess and improve additive combustion behavior at low fuel and air temperatures. Tested fuel candidates in bench scale rigs simulating advanced high Mach propulsion systems. 									
(U)	In FY 2008: Continue conducting lab-sca degrees Fahrenheit including thermal stab improved materials and coatings. Continu management simulator. Complete the dev behavior at low fuel and air temperatures. high Mach propulsion systems and the High	le evaluation of ility additives, the effort to valid velopment of ap Continue to te ghly Efficient E	f approaches to fuel deoxygena date componen proaches to ass st fuel candidat Embedded Effic	increase JP-8 t tion, advanced t performance r sess and improv- tes in bench sca cient Turbine E	temperature cap alternative fue models on aircr ve additive com ale rigs simulati ngine (HEETE	bability to 900 ls, and raft thermal abustion ing advanced). Develop a				
Proje	ect 3048			R-1 Line Iten Page-8 c 142	n No. 11 of 35 o				Exhibit R-2a (I	PE 0602203F)

BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602203F Aerospace Propulsion (U) B. Accomplishments/Planned Program (\$ in Millions) FY robust mechanical and integrated engine thermal management system (mechanical and fuel systems) for optimum engine performance and durability at sustained supersonic cruise conditions. FY (U) In FY 2009: 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. Continue effort to validate component performance models on aircraft thermal management simulator. Continue to test fuel candidates in bench scale rigs simulating advanced high Mach	ROJECT NUMBER AND T 048 Fuels and Lubri 2007 FY 2008 342 1 206	ITLE cation <u>FY 2009</u>
 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> FY robust mechanical and integrated engine thermal management system (mechanical and fuel systems) for optimum engine performance and durability at sustained supersonic cruise conditions. (U) In FY 2009: 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. Continue effort to validate component performance models on aircraft thermal management simulator. Continue to test fuel candidates in bench scale rigs simulating advanced high Mach 	2007 <u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Continue conducting fab-scale evaluation of approaches to increase JP-8 temperature capability to 900 degrees Fahrenheit including thermal stability additives, fuel deoxygenation, advanced alternative energy fuels, and improved materials and coatings. Continue effort to validate component performance models on aircraft thermal management simulator. Continue to test fuel candidates in bench scale rigs simulating advanced high Mach	342 1 206	
propulsion systems and the HEETE. Conduct full-scale component rig testing of mechanical components with experimental lubricants. Conduct simulated high-Mach tests of an integrated thermal management system and mechanical system components.	342 1 206	
 (U) (U) MAJOR THRUST: Develop advanced additive approaches to reduce engine emissions and signature (including 	.542 1.200	1.785
 nano-scale additives), as well as advanced emission diagnostic test protocols. (U) In FY 2007: Assessed novel fuel additives including nano-technologies and fuels derived from alternative energy resources to reduce emissions in laboratory scale combustion rigs. Initiated higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion. 		
(U) In FY 2008: Complete assessing novel fuel additives including nano-technologies to reduce emissions in laboratory scale combustion rigs. Initiate improvement of combustion models for kerosene fuels. Continue higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion		
 (U) In FY 2009: Continue higher-pressure measurements of additive and fuel effects on sub-micron particulate generation during combustion. Initiate study of NOx/soot trade offs in combustor design. Continue improvement of combustion models for kerosene fuels. 		
 (U) (U) MAJOR THRUST: Study and evaluate low-cost approaches to reduce fuel logistics footprint to simplify logistics and reduce cost (including field and on-board additive injections and improvements to existing fuel additive packages), as well as study fuel logistics vulnerabilities and develop detection and mitigation technologies. 	.341 1.207	1.785
 (U) In FY 2007: Investigated performance of Fischer-Tropsch (F-T) and other alternative fuels for aircraft and other field hardware. Evaluated advanced nano-technology fuel sensors, nano-technology fuel additives, and novel detection and mitigation technologies for biological growth 		
 (U) In FY 2008: Expand investigation of the performance of alternative fuels to include bio-derived fuels. Initiate development of bioreactors to simulate biological growth in aircraft fuel systems and ground storage facilities. Initiate development of knowledge base for certification of Fischer-Tropsch fuels for all Air Force tactical vehicles Continue evaluation of advanced nano-technology fuel sensors, nano-technology fuel additives, and novel detection 		
Project 3048 R-1 Line Item No. 11 Page-9 of 35	Exhibit F	R-2a (PE 0602203F)

	Exhibit R-2a, RDT&E Project Justifi	DATE February 2008				
BUD(02 A	GET ACTIVITYPpplied Research0	E NUMBER AND TITLE 602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication			
(U)	B. Accomplishments/Planned Program (\$ in Millions) and mitigation technologies for biological growth.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Continue to investigate performance of biomass-derived fuels for aircraft Initiate extension of knowledge base to other alternative fuels, such as those derived fre development of bioreactors to simulate biological growth in aircraft fuel systems and g Continue development of knowledge base for certification of Fischer-Tropsch fuels for vehicles.	and other field hardware. om biomass. Continue round storage facilities. all Air Force tactical				
(U) (U)	MAJOR THRUST: Investigate hydrocarbon and other high energy density fuels for ac	lvanced and combined cycle	0.670	0.690	0.765	
(U)	engines for high-speed aerospace vehicles and low-cost boost applications. In FY 2007: Assessed advanced hydrocarbon propellant stability under high heat flux improved fuel property data for hydrocarbon propellant database.	conditions. Collected				
(U)	In FY 2008: Complete study of refined kerosene propellants under high heat flux cond study synthesized high-energy hydrocarbons. Continue to improve fuel property datab improve design tools.	litions, while continuing to ase and share with industry to				
(U)	In FY 2009: Continue study of high-energy hydrocarbon propellant candidates. Comp property database for kerosene propellants at high pressure. Continue to collect improve energy hydrocarbons and improve physical property models.	blete improved physical ved physical property for high				
(U)						
(U)	MAJOR THRUST: Develop, test, and evaluate revolutionary combustor and propulsion pulsed detonation, and combined cycle engines for missiles, manned and unmanned sy space; perform payoff analyses and configuration trade studies for these systems; and e emissions characteristics of fuels and fuel additives.	on concepts for gas turbine, stems, and reuseable access to evaluate the combustion and	4.526	4.310	5.864	
(U)	In FY 2007: Evaluated advanced combustion system performance at realistic operating inter-turbine burning concepts for large gas turbine engines. Integrated of Pulse Deton turbine-based hybrid concept. Evaluated and optimized advanced combustor, augment modeling and simulation tools.	g conditions. Investigated ation Engine (PDE) into tor, and PDE concepts using				
(U)	In FY 2008: Demonstrate small-scale inter-turbine burner (ITB) concepts in a relevant Investigate the scalability of inter-turbine burners for large engines. Assess an integrat turbine concept performance with component fabrication and evaluation. Investigate c systems for high-altitude low-high mach applications. Evaluate and optimize advanced PDE concepts using modeling and simulation tools.	t engine environment. ed pulsed detonation/hybrid ombustor and augmentor d combustor, augmentor, and				
(U)	In FY 2009: Evaluate advanced combustion system performance at realistic operating	conditions. Demonstrate				
	R-1 Line Iten	n No. 11			/ 	
Pro	ect 3048 Page-10	of 35		Exhibit R-2a	(PE 0602203F)	

	Exhibit R-2a, RDT&E Project Jus	DATE February 2008				
budo 02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication			
(U)	B. Accomplishments/Planned Program (\$ in Millions) small-scale ITB concepts in small engine. Identify concept designs of inter-turbine turbine engines. Optimize component efficiency of the integrated pulsed detonation optimize advanced combustor, augmentor, and PDE concepts using modeling and flight conditions and applications.	burning concepts for large gas on/hybrid turbine. Evaluate and simulation tools covering wider	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
ധ	ingit conditions and approvations.					
(U)	MAJOR THRUST: Develop approaches to extend the life of endothermic fuels an sustained supersonic and reusable hypersonic cruise applications.	0.670	0.690	0.765		
(U)	In FY 2007: Developed improved surfaces/catalysts to mitigate coking and thus in Assessed unconventional approaches to increase fuel heat sink and minimize regent including low heat rejection structures.	nprove fuel heat sink capability. lerative cooling heat loads,				
(U)	In FY 2008: Evaluate improved coke-mitigating surfaces/catalysts with 2nd gener bench-scale heat exchanger rigs. Assess unconventional approaches to increase fu regenerative cooling heat loads in panel tests. Initiate study of relationship betwee combustion behavior including blowout.	ation endothermic fuels in el heat sink and minimize n fuel structure/properties and				
(U)	In FY 2009: Continue bench-scale tests to evaluate improved surfaces/catalysts for fuels. Continue assessment of unconventional approaches to increase fuel heat sin cooling heat loads. Continue study of relationship between fuel structure/properties including blowout.	r 2nd generation endothermic k and minimize regenerative s and combustion behavior				
(U)						
(U)	MAJOR THRUST: Develop and demonstrate optical, electromechanical, and lase application to revolutionary propulsion technologies.	r diagnostic tools and sensors for	0.670	0.862	1.020	
(U)	In FY 2007: Applied advanced diagnostics in a relevant gas turbine combustion sy diagnostics to sensor development and validated sensors in relevant gas turbine engets to obtain benchmark-quality data for improvement of combustion more	stem environment. Applied gine system. Conducted deling and simulation tools				
(U)	In FY 2008: Demonstrate high-bandwidth (e.g., MHz-rate) planar laser-induced fl imaging of key combustion species in fundamental laboratory flames and relevant terahertz radiation (T-rays) for combustion temperature sensing and non-destructiv engine components. Integrate current and next-generation combustion diagnostics solutions for fighter aircraft	uorescence for high-speed digital engine environments. Apply re inspection/evaluation of turbine to support RDT&E of augmentor				
(U)	In FY 2009: Develop high-speed techniques for measuring carbon monoxide (CO) combustion efficiency in near constant volume combust on turbine environments. femtosecond), ultraintense (e.g., terawatt) laser systems to generate ultrashort x-ray) to evaluate CO oxidiation and Exploit ultrafast (e.g., y bursts for soot-mitigation studies				
Proj	ect 3048 R-1 Line Page	e Item No. 11 9-11 of 35		Exhibit R-2a	(PE 0602203F)	
		145				

	Exhibit R-2a, RDT&E Project Justific	DA	DATE February 2008			
budo 02 A	PE ACTIVITY PE	NUMBER AND TITLE 602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication			
(U)	B. Accomplishments/Planned Program (\$ in Millions) and dense fuel spray imaging. Develop multi-pulse femtosecond ballistic imaging to un sprays in combustor, augmentor, scramjet, and rocket applications.	iderstand and improve fuel	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Develop, test, and qualify advanced turbine engine lubricants for th requirements and transition opportunities for new oils by working with DoD agencies, i and maintain military specifications for aviation engine lubricants, as well as continued aviation lubrication technologies and DoD operational units.	ne Air Force. Establish target ndustry, and users. Generate field support activities for	2.514	2.413	3.315	
(U)	In FY 2007: Began technology insertion of advanced bearing and lubrication system comaterials for improved engine performance, affordability, and engine health monitoring engines. Conducted testing to focus and develop lubricants and mechanical systems for UAV turbine engines. Initiated 7cSt ester lubricant development for high Mach/high tecommercial turbine engines. Coordinated and supported demonstration of Joint Oil Profighter asset engines. Delivered military specifications and test methods for DoD lubric engines.	oncepts, components, and into demonstrator cores and man-rated, expendable, and mperature military and ogram lubricants in new cants to support new fighter				
(U)	In FY 2008: Complete qualification testing of the enhanced 5cSt ester candidate(s), tran program and draft new oil specification. Ramp up qualification testing of hi-mach 7cSt 2011 engine demo. Develop an integrated and effective bearing/oil health monitoring specification testing to address critical DoD safety, readiness, and life-cycle cost concerns. Condulong-term, low-temperature (high-altitude) performance of engine lubricants and develop mechanical system for highly efficient embedded turbine engines.	nsition to demo engine ester in preparation of FY ystem with prognostics act technology assessment of op concepts for efficient				
(U)	In FY 2009: Demonstrate enhanced 5cSt ester lubricant in Joint Strike Fighter thrust gr and begin fielding new enhanced 5cSt oil specification. Conduct qualification testing o lubricant. Demonstrate an integrated bearing/oil health monitoring/prognostic system in validate life models. Fabricate and test an efficient mechanical system for highly efficie and adaptive versatile turbine engines (ADVENT). Continue development of high-temp Range Strike aircraft.	owth demo engines. Finalize f new hi-mach 7cSt ester n full-scale setting and ent embedded turbine engine perature lubricants for Long				
(U)						
(U)	MAJOR THRUST: Develop and test advanced bearing material technology and bearing intermediate, and large-sized turbine engine applications.	g concepts for small,	2.850	2.758	3.570	
(U)	In FY 2007: Conducted airfoil bearing tests in larger shaft diameter sizes to determine limitations of this technology. Developed and tested of affordable rotor support technol and large-sized turbine engine applications. Validated modeling and simulation tools to	load capacity and rotor size logy for small-, intermediate-, o advance design, shorten				
Proj	ect 3048 R-1 Line Item Page-12 o	No. 11 f 35		Exhibit R-2a	(PE 0602203F)	
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	Exhibit R-2a, RDT&E Project Jus	DATE February 2008			
BUDGE 02 Ap	T ACTIVITY plied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication		
(U)] (U)](B. Accomplishments/Planned Program (\$ in Millions) development time, and reduce test requirements for mechanical and electromagnet generation systems. Improved the modeling of airfoil shaft bearings and initiated of opportunities for advanced engine rotor support and power generation. Transitione technology to bearing and engine companies. Demonstrated hybrid (metal/ceramic new fighter demonstrator engines. Initiated programs for hardware needed for option for high mach/high temperature turbine engines and accelerators. Expanded the pro- support and power generation for turbine and combined cycle engines.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)]] [[[]	In FY 2008: Demonstrate new fatigue and spall propagation resistant bearing mate with enhanced 5cSt oil. Conduct subscale fatigue life and spall propagation studie ni-mach 7cSt oil candidates. Develop preliminary design of propfan gearbox and o efficient mechanical system components (i.e., rolling element versus foil versus mate the FX 2000: Continue complete sub-scale fatigue life and shall propagation studies	erials in advanced demo engines s of bearing materials with conduct trade study of energy agnetic bearing) for HEETE.			
	spall propagation models through with hi-mach 7cSt oil candidates and begin full-spall propagation models through with hi-mach 7cSt oil candidates and begin full-spropfan gearbox in support of ADVENT. Down select mechanical system comport for highly efficient embedded turbine engines and ADVENT engines.	scale tests. Fabricate and test nents and complete detailed design			
(U) (U) (CONGRESSIONAL ADD: Ultrafast, Ultraintense Laser Microfabrication and Dia Ultrafast Laser Microfabrication and Diagnostics).	agnostics (formerly Intense,	0.981	0.000	0.000
(U)] f	In FY 2007: Established the technical base required to evaluate and develop ultraf fabrication, inspection, and repair of components for aerospace propulsion and oth	ast, ultraintense lasers for er weapon systems.			
(U) 1 (U) 1 (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U) [(U)]	CONGRESSIONAL ADD: Research Institute for Environmental Studies. In FY 2007: Accelerated the development and demonstration of a modular, portable that can meet EPA standards and can be deployed to forward bases within 24 hours.	le wastewater treatment system s.	1.962	0.000	0.000
(U)] (U)] (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U) 1 (U) 1	CONGRESSIONAL ADD: High Energy Laser for Detection Inspection and Non- In FY 2007: Developed high-energy laser techniques for use as a non-destructive turbine engine components.	Destructive Testing. technique for inspection of gas	2.649	0.000	0.000
Projec	rt 3048 R-1 Line Page	e Item No. 11 e-13 of 35		Exhibit R-2a	(PE 0602203F)

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER A 0602203F A	ND TITLE erospace Pro	pulsion	PROJECT NUM 3048 Fuels a	BER AND TITLE Ind Lubricati	on
(U) (U) (U)	B. Accomplishments/Planned Prop In FY 2008: Not Applicable. In FY 2009: Not Applicable.	gram (\$ in Mil	<u>lions)</u>					<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	 CONGRESSIONAL ADD: Hybrid Bearings. In FY 2007: Developed a suite of advanced hybrid bearing technologies for transition to JSF thrust growth and advanced VAATE turbine engines. Demonstrated hybrid P675 bearing in JSF in accelerated mission engine test (Jul 07). Optimized P675 heat treatment for enhanced spall propagation resistance. Developed bearing spall and crack propagation models. Developed advanced bearing cages for improved bearing performance. 							1.668	2.385	0.000
(U) (U)	In FY 2008: Demonstrate optimized P675 bearings. Demonstrate nondes Continue developing high performan In FY 2009: Not Applicable.	d P675 bearing structive evaluation of the structure of t	steel in sub-sca ation (NDE) equ ge.	le bearings. Cor ipment for silico	ntinue manufactu on nitride rolling	re of full-scale elements.				
(U) (U) (U) (U)	 J) CONGRESSIONAL ADD: Alternative Energy Research J) In FY 2007: Not Applicable. J) In FY 2008: Perform research on alternative energy, focusing on alternative hydrocarbon fuels made from coal, biomass, oil shale. Research includes fuel property evaluation and enhancement, as well as component and engine testing of alternative fuels. 							0.000	9.937	0.000
(U) (U) (U) (U) (U)	 In FY 2009: Not Applicable. U) U) CONGRESSIONAL ADD: WASH Oxygen Sensor and Cell Level Battery Controller U) In FY 2007: Not Applicable. U) In FY 2008: Conduct research for the development of oxygen sensors for aircraft wing tanks with specific emphasis on evaluating performance and durability in realistic operating environments. Develop a cell level battery 						5	0.000	1.192	0.000
(U) (U)	In FY 2009: Not Applicable. Total Cost							24.022	30.752	25.497
(U) (U) (U)	C. Other Program Funding Summa Related Activities: PE 0601102F, Defense Research	ary (\$ in Milli FY 2007 Actual	<u>ons)</u> <u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> Estimate	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> Complete	<u>Total Cost</u>
Pro	oject 3048			R-1 Line Page	Item No. 11 -14 of 35 148				Exhibit R-2a	(PE 0602203F)

Exhibit R-2a, RDT8	Exhibit R-2a, RDT&E Project Justification					
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NUMBER AND TITLE 3048 Fuels and Lubrication				
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Sciences. (U) PE 0602805F, Dual Use Science and Technology. (U) PE 0603216F, Aerospace Propulsion and Power Technology. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate 						
 (U) <u>D. Acquisition Strategy</u> Not Applicable. 						
Project 3048	R-1 Line Item No. 11 Page-15 of 35	Exhibit R-2a (PE 0602203				

	Exh	nibit R-2a, R	DT&E Pro	ject Justifi	ication			DA	February	2008
BUDG 02 A	ET ACTIVITY pplied Research			P 0	E NUMBER AND	TITLE	ulsion	PROJECT NUMBER AND TITLE 3066 Turbine Engine Technology		
	Cost (\$ in Millions)	FY 2007 Actual	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	48.345	56.247	87.771	71.314	49.947	47.101	49.0	024 Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0	
Note: engin (U)	The funding in this project has been increases. A. Mission Description and Budget Item	ased to provide Justification	emphasis on a	daptive cycle to	echnologies, ind	creased fuel eff	iciency, and h	ighly efficie	ent embedded turbi	ne
	consumption, and cost of ownership. Analysistems, controls, augmentor and exhaust s design. This project supports the Integrated technology on national needs. The program warfighting, tactical and global mobility, readaptive cycle technologies. This effort de for widely varying mission needs. A portice technologies that enable the use of domestic	ytical and exper systems, integrat d Versatile Affo n plan reflects the esponsive space velops compone on of the project c fuel sources for	imental areas of red power and rdable Advance he technology lift, and persis ent technology supports the E pr military energy	of emphasis are thermal manag eed Turbine Eng base support fo tent Intelligence for an adaptive Energy Conservery rgy needs.	e fans and comp gement systems, gine (VAATE) or VAATE active ce, Surveillance e cycle engine a vation-Assured	pressors, high te , engine inlet in program and in vity applicable to , and Reconnai architecture tha Fuels Initiative	emperature con tegration, mec ndustry efforts to global respo ssance (ISR). t provides opti . This effort io	nbustors, tu hanical syst to focus tur onsive strike A portion o mized perfo dentifies, an	rbines, internal flo tems, and structura chine propulsion e, capable unmanne of this project supp- ormance/fuel effici- id evaluates	w l ed orts ency
(U) (U)	J) B. Accomplishments/Planned Program (\$ in Millions) FY 2007 FY 2008 FY 2009 J) MAJOR THRUST: Develop core turbofan/turbojet engine components (i.e., compressors, combustors, and 20.839 20.839 33.267 65.828 high-pressure turbines) for fighters, bombers, sustained supersonic/hypersonic cruise vehicles, and transports. Identify, and evaluate technologies that enable the use of domestic fuel sources for military energy needs. Develop advanced concepts, designs, design rules, and computational tools to support component research and rig testing of 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 ambadie of ficiency and affection and pressure losses. Note: Increased funding in FY 2008 and out due to ambadie of ficiency and pressure losses. Note: Increased funding in FY 2008 and out due to ambadied turbine consinger									
(U)	In FY 2007: Developed and applied advar Incorporated advanced materials into inno blades, turbine vanes, and turbine rear fran cooling flow and increase life. Designed a Conducted rig tests and design optimization loads on hot section components. Designed large radius rotating air seals, a low profile	nced modeling a ovative designs a me. Designed a and demonstrate on of effective, o ed, fabricated, a e annular combo	and simulation and analyzed C nd analyzed til ed a very short, durable, radiati nd rig tested fa ustor, and a lar	rules and tools Ceramic Matrix led turbine airfo , high efficiency ion barrier coat an/radial compr ge-scale casting	s for advanced of Composite (Ch oil technology t y afterburner co tings to reduce to ressor internal a g of fan/radial of	components. MC) turbine to reduce oncept. the radiant heat perodynamics, compressor.				
Proje	ect 3066			R-1 Line Item Page-16	n No. 11 of 35				Exhibit R-2a (PE 0602203F)

Exhibit R-2a, RDT&E Project Justification	Di	February	2008
BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602203F Aerospace Propulsion	PROJECT N 3066 Turk	UMBER AND TITLE	hnology
 (U) B. Accomplishments/Planned Program (\$ in Millions) (U) In FY 2008: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Develop and optimize novel dual fuel burner. Determine suitability of latest Titanium Aluminide materials for Mach 4 compressor application. Develop and apply advanced modeling and simulation rules and tools to significantly improve component efficiencies, enabling reduced fuel consumption in emerging and future gas turbine propulsion systems. Develop and apply advanced modeling and simulation rules and tools to initiate definition and design of lightweight, simple, adaptive cycle features. Develop and apply advanced modeling and simulation rules and tools to initiate definition and design of lightweight, simple, adaptive cycle features. Develop and apply advanced modeling and simulation rules and tools to initiate definition and design of an efficient, wide-flow range compressor, an efficient, high temperature turbine capable of operating over large swings in required work, and an efficient, lightweight, LO-compatible exhaust system. Develop and apply advanced modeling and simulation rules and tools to initiate definition and design of an efficient, very high pressure ratio compressor and associated thermal management features that will offer a step change improvement in engine Specific Fuel Consumption (SFC). (U) In FY 2009: Continue to develop and apply advanced modeling and simulation rules and tools for advanced components. Conduct rig testing of advanced high pressure turbine vane and blade nano-laminate thermal barrier coating (TBC) applied. Begin to develop computational fluid dynamics methodology for analyzing turbine flows. Begin to develop CMC lifting models. Conduct bench and rig tests for validation of components with significantly improved efficiency. Continue rig testing of lightweight, simple, adaptive cycle features, an efficient, wide-flow range compressor, an efficient, high temperature turbine	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) MAJOR THRUST: Develop turbofan/turbojet engine components (i.e., fans, low pressure turbines, engine controls, exhaust nozzles, and integration technologies) for turbofan/turbojet engines for fighters, bombers, sustained supersonic strike and hypersonic cruise vehicles, and transports. (U) In FY 2007: Identified and quantified sources of variability and uncertainty affecting turbine blade durability performance (oxidation, creep, thermal material fatigue, high cycle fatigue, etc.). Applied advanced materials systems to innovative designs to determine wear reduction, improve load capacity, and increase temperature capability of five centi-stokes oil and to assess aerodynamics, operability, aeromechanics, and acoustic characteristics of a counter-rotating fan-on-blade (FLADE) concept. Conducted design optimization for turbine blade microcircuit cooling. Tested pilot and fuel injection concepts in a single-flameholder rig to evaluate fundamental capabilities. (U) In FY 2008: Continue to develop and apply advanced modeling and simulation rules and tools for advanced 	12.975	12.283	15.799
Project 3066 R-1 Line Item No. 11 Project 3066 Page-17 of 35		Exhibit R-2a	(PE 0602203F)

BUDGET ACTIVITY PE NUMBER AND	PROJEC		
02 Applied Research 0602203F Aer	ospace Propulsion 3066 T	T NUMBER AND TITLE urbine Engine Tec	hnology
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> components. Conduct risk reduction testing of variable bypass ratio fan concept. Develop and rig tes augmentor technology to significantly decrease burning length. Design and fabricate an advanced lig variable area exhaust nozzle.	FY 2007 t reheat htweight,	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Continue to develop and apply advanced modeling and simulation rules and tools for ad- components. Develop durable damping/erosion coating systems. Conduct rig testing of advanced far application to a variable cycle engine concept.	vanced a design for		
 (U) (U) MAJOR THRUST: Develop limited life engine components for missile and unmanned air vehicle appincluding long-range supersonic and hypersonic vehicles. These efforts enable engines with reduced fuel consumption, and increased specific thrust, thereby greatly expanding the operating envelopes of unmanned vehicles. 	plications, 3.932 cost, reduced missiles and	4.094	5.266
(U) In FY 2007: Rig tested a slinger-fed, dual-fuel CRC. Developed and applied advanced modeling and rules and tools for advanced components (i.e., high cycle fatigue, computational fluid dynamics, cycle propulsion system models, component life models, probabilistic models, etc.). Rig tested a fuel-coole Designed and analyzed a five-stage forward swept compressor.	simulation e analyses, ed turbine.		
(U) In FY 2008: Utilize data from high speed turbine engine testing of a wide-range, lightweight carbon- area exhaust nozzle and a compact, carbon-carbon ramburner to update and validate advanced modeli simulation rules and tools.	carbon variable ng and		
 (U) In FY 2009: Utilize data from high speed turbine engine testing of a fuel cooled turbine and a slinger- CRC to update and validate advanced modeling and simulation rules and tools. 	-fed, dual-fuel		
 (U) MAJOR THRUST: Develop components for turboshaft/turboprop and small turbofan engines for trai special operations aircraft, and theater transports. 	ners, rotorcraft, 1.573	1.535	0.878
(U) In FY 2007: Developed and applied advanced modeling and simulation rules and tools for advanced of Applied advanced materials systems to innovative designs and analyze a nano-laminate thermal barrier Developed new and innovative design concepts and conducted bench and rig tests for validation of a l release combustor design and an advanced forward swept, centrifugal compressor design.	components. er coating. nigh heat		
(U) In FY 2008: Develop new and innovative design concepts and conduct bench and rig tests for validat flow turbine design.	ion of a mixed		
(U) In FY 2009: Utilize data from efficient small scale engine testing of an advanced forward swept, cent compressor, and a silicon nitride mixed flow turbine to update and validate advanced modeling and si and tools.	rifugal mulation rules		
Project 3066 R-1 Line Item No. 11 Project 3066 Page-18 of 35		Exhibit R-2a	(PE 0602203F)

	Exhibit R-2a, RDT&E Project Justific	DA	TE February	2008	
BUD(02 A	GET ACTIVITYPE pplied Research 06	NUMBER AND TITLE 02203F Aerospace Propulsion	PROJECT NI 3066 Turb	JMBER AND TITLE	hnology
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	CONGRESSIONAL ADD: VAATE TMC FLADE Technology Demonstration (former Composites)	rly VAATE-Titanium Matrix	1.079	0.000	0.000
(U) (U) (U)	In FY 2007: Developed Titanium Matrix Composites for advanced turbine engine comp In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ponents.			
(U) (U) (U)	CONGRESSIONAL ADD: Active Combustion Control System for Military Aircraft. In FY 2007: Developed advanced Active Combustion Control System (ACCS) compon future engine development programs.	ents for use in ongoing and	1.766	0.000	0.000
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U)	CONGRESSIONAL ADD: Advanced Affordability Assurance Tools for the Versatile A Engine (VAATE) Initiative. In FY 2007: Developed state-of-the-art computer software tools that will estimate devel maintenace costs for advanced technology turbine engines.	Affordable Advanced Turbine opment, production, and	0.981	0.000	0.000
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U) (U) (U)	CONGRESSIONAL ADD: Intelligent Engine Technology Development for UAVs. In FY 2007: Developed turbine engine life management software to reduce overall engi In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ne maintenance costs.	1.374	0.000	0.000
(U) (U)	CONGRESSIONAL ADD: Active Combustion Control Systems for Military Aircraft. In FY 2007: Developed advanced active combustion control system components for use engine development programs.	e in ongoing and future	3.826	3.478	0.000
(U) (U) (U)	In FY 2008: Continue to develop Active Combustion Control Systems for military aircr In FY 2009: Not Applicable.	aft.			
(U)	CONGRESSIONAL ADD: VDVP for UAV/UCAV Aircraft Engines		0.000	1.590	
Pro	ect 3066 R-1 Line Item 253 R-1 Line Item 253 R-1 Line Item 253 R-1 Line Item	No. 11 35		Exhibit R-2a	(PE 0602203F)

	Exhibit R-2a, RDT&E Project Justification								February	2008	
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER AND TITLE PRO 0602203F Aerospace Propulsion 300			PROJECT NUM 3066 Turbin	PROJECT NUMBER AND TITLE 1066 Turbine Engine Technology		
 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct research and development on variable displacement vane pumps for (U) In FY 2009: Not Applicable. 						d UCAV engine	<u>]</u> :s.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	Total Cost							48.345	56.247	87.771	
(U)	C. Other Program Funding Sum	<u>nary (\$ in Millio</u>	<u>ons)</u>								
(U) (U) (U) (U)	Related Materials: PE 0601102F, Defense Research Sciences. PE 0602102F, Materials. PE 0603216F, Aerospace Propulsion and Power	<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>		
(U) (U) (U) (U)	Technology. PE 0602122N, Aircraft Technology. PE 0603210N, Aircraft Propulsion. PE 0603003A, Aviation Advanced Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy										
Pro	Not Applicable.			R-1 Line Page	e Item No. 11 ∋-20 of 35 154				Exhibit R-2a	(PE 0602203F)	

Γ	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUD(02 A	GET ACTIVITY Applied Research			P 0	E NUMBER AND	TITLE ospace Prop	ulsion	PROJECT NUME 3145 Aerosp	BER AND TITLE	echnology
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
314	5 Aerospace Power Technology Quantity of RDT&E Articles	43.560 0	44.201 0	29.280 0	29.588 0	29.798 0	31.534 0	31.889 0	Continuing	TBD
(U)	A. Mission Description and Budget Item This project develops electrical and therma reliability, maintainability, commonality, a power system technologies to enable specia weapon systems. This project supports dev aircraft platforms including strike and mob	Justification I management t ffordability, and al purpose appli velopment of ele ility concepts.	echnologies fo d supportability cations. Electre ectrical power a Lightweight po	r military aeros of aircraft and rical power and and thermal ma ower systems su	space application of flight line equal thermal management com uitable for other	ons. Power cor ipment. Resea gement technol ponent and sys r aerospace app	nponent techno rch is conducte ogies enable al tems suitable f blications are a	blogies are deve ed in energy sto Il future military for applications lso developed.	eloped to increat orage and hybrid y directed energ to legacy and f	.se 1 3y `uture
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop electrical por manned and unmanned aircraft systems. T maintainability, and supportability, while electrical power and thermal management technologies for special purpose application 2008 and on due to Air Force emphasis or and emerging aircraft and UAVs. In FY 2007: Fabricated and characterized testing of an advanced switched reluctance	(\$ in Millions) ower and therma These technolog reducing life cy , including ener ons enabling lon n developing tec l next generatio e machine cont	al management gies improve ai cele costs and e gy conversion, ng endurance n chnologies to a n solid state litt coller. Comple	component and rcraft range, se nabling new ca /storage, componissions. Note: ddress thermal hium-based thin ted preliminary	d subsystem tec elf-sufficiency, a apabilities. Dev onents and subs : Funding increa management is n film cells. Co y aircraft therm	chnologies for reliability, velop hybrid system easing in FY ssues of current ompleted al management	<u>FY</u> 1	<u>7 2007</u> 1.185	<u>FY 2008</u> 16.518	<u>FY 2009</u> 23.717
(U) (U)	 testing of an advanced switched refluctance machine controller. Completed preliminary aircraft thermal management studies and identified high efficiency design candidates. J) In FY 2008: Develop and design high efficiency, high power, high temperature power electrical components. Develop and test air vehicle electromagnetic and radio frequency effects immune components. Design and fabricate thermal management components and subsystems. Initiate studies, modeling and simulation, and develop preliminary designs for energy harvesting and energy dense, long endurance battery, and fuel cell components and subsystems. Develop and test rechargeable/refuelable, lightweight, energy dense, high power hybrid battery, fuel cell and power management components and subsystems. U) In EX 2009: Eabricate integrate and test high efficiency high power wide temperature range power electrical 									
(U) (U)	components. Initiate integration and test a components. Integrate and test thermal m MAJOR THRUST: Develop electrical po conditioning components, and subsystem	air vehicle elect anagement com ower and therma technologies fo	romagnetic and aponents and su al management r aerospace apj	l radio frequen ibsystems. , energy conver plications. Not	cy effects imm rsion/storage ar e: In FY 2007,	une nd power , this activity		4.120	0.000	0.000
Pro	ject 3145			R-1 Line Iten Page-21 155	n No. 11 of 35				Exhibit R-2a (PE 0602203F)

	Exhibit R-2a, RDT&E Project Justific	cation	DATE February 2008			
BUD(02 A	GET ACTIVITYPEpplied Research06	NUMBER AND TITLE 02203F Aerospace Propulsion	PROJECT N 3145 Aero	UMBER AND TITLE	echnology	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
an	will be completed. In EV 2007: Completed scale up, modeling efforts and flight tests of ten kW spray cool	ling technology				
(0)	In FY 2007. Completed scale-up, modering errors and right tests of ten kw spray cool In FY 2008: Not Applicable	ning technology.				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	MAJOR THRUST: Develop lightweight electrical power and thermal management contechnologies with low volume displacement to enable delivery of high power for operative weapons. Note: In FY 2009, this thrust is reduced due to higher AF priorities.	nponent and subsystem ion of directed energy	14.127	14.070	1.171	
(U)	In FY 2007: Designed high rate lithium-ion (liquid) battery system for directed energy	applications. Completed				
	fabrication and begin testing proof-of-concept superconducting generator.					
(U)	In FY 2008: Develop and initiate design of a flight-weight superconducting generator, l energy storage and high voltage/current components and subsystems. Develop concept multimegawatt generator.	high rate charge/discharge designs for superconducting				
(U) (U)	In FY 2009: Investigate high-rate thermal energy storage for directed energy applicatio	ns.				
(U)	MAJOR THRUST: Develop hybrid electrical power and thermal management, includir components and subsystem technologies for special purpose applications enabling long In FY 2009, efforts in this thrust are broken out from previous thrust to better address fu component development in support of electric hybrid special programs.	ng energy conversion/storage, endurance missions. Note: ature increased emphasis on	0.000	0.000	4.392	
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Integrate and test thermal management components and subsystems. Integrate of flight-weight efficient energy harvesting hybrid battery and fuel cell component	grate and initiate subsystems				
an	test of finght-weight, efficient, energy harvesting, hybrid battery and fuer een componen					
(U)	CONGRESSIONAL ADD: High Flux ESC System with TES for Military High Energy	/ Laser.	1.079	0.000	0.000	
(U)	In FY 2007: Developed evaporative spray cooling techniques for cooling high heat flux	tactical lasers.				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Affordable Lightweight Power Supply Development.		0.981	0.000	0.000	
(U)	In FY 2007: Developed alternative high performance electrolytes and low-cost membra (MEA's), which are capable of operating at high temperatures, zero or reduced humilitie	ane electrode assemblies es and which enable				
Pro	ect 3145 R-1 Line Item Page-22 o	No. 11 f 35		Exhibit R-2a	(PE 0602203F)	
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	Exhibit R-2a, RDT&E Project Just	ification	D/	February	2008
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT N 3145 Aero	IUMBER AND TITLE	echnology
(U)	<u>B. Accomplishments/Planned Program (\$ in Millions)</u> decreased system complexity and improved utilization of high energy fuels.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U) (U)	CONGRESSIONAL ADD: MEPS (Multimegawatt Electric Power System) Therma In FY 2007: Developed a multimegawatt electric power system. In FY 2008: Not Applicable	al Management.	1.275	0.000	0.000
(U) (U)	In FY 2009: Not Applicable.				
(U) (U)	CONGRESSIONAL ADD: Chemical Hydride Power System (formerly Portable Po Chemical Hydrides). In FY 2007: Further developed the technologies necessary to improve the reliability hydride replacement cartridges for Airmen portable power systems.	wer Solution Employing and compactness of chemical	2.453	0.000	0.000
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U)	CONGRESSIONAL ADD: Advanced Energy Technology for Munitions - Dominat In FY 2007: Developed a compact, flight weight solid oxide fuel cell based power s munition.	or Program. ystem for the Area Dominator	1.275	0.000	0.000
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U) (U)	CONGRESSIONAL ADD: Military Purpose Electrolyte Supported Fuel Cells. In FY 2007: Developed high power dense advanced solid oxide fuel cell stack techn Specific objectives included stack scale-up, internal reformation development, and s In FY 2008: Not Applicable.	nology for UAV applications. ystem modeling.	0.981	0.000	0.000
(U) (U)	In FY 2009: Not Applicable.				
(U) (U) (U)	CONGRESSIONAL ADD: Manufacturing of High Energy Superior Lithium Batter In FY 2007: Developed the Superior Lithium Polymer Battery (SLPB) technology f advanced military aircraft battery with a goal cycle life equal to 5000 cycles at 80 pe In FY 2008: Develop and design equipment and processes for domestic production	y Technology. For a 5, 28 and 270 VDC ercent Depth of Discharge. of SLPB batteries and develop	5.103	5.962	0.000
Pro	ect 3145 R-1 Line I Page-2	tem No. 11 23 of 35		Exhibit R-2a	(PE 0602203F)

	Exhibit R-2a, RDT&E Project Just	ification	DA	February	2008
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT N 3145 Aero	UMBER AND TITLE Space Power T	echnology
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) appropriate anode, cathode and electrolyte materials for prototype production of cell In FY 2009: Not Applicable.	s and batteries.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Integrated Electrical Starter/Generator. In FY 2007: Developed technologies necessary to raise the technology readiness lev Efforts included a detailed design of a production-configuration Inverter-Converter O In FY 2008: Continue detailed design and development to increase the technology re lightweight, compact, high temperature starter generator and Inverter-Converter Conv In FY 2009: Not Applicable.	el of integral starter/generators. Controllers (ICCs). eadiness level (TRL) of trollers (ICCs).	0.981	1.988	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced Fuel Cell Based Power System for Small UAV In FY 2007: Not Applicable. In FY 2008: Develop power systems for small/micro UAV systems. Examine mirco determine the size, weight and power requirements needed to power these small aircr and initial design of fuel cell systems to meet specifications resulting from the requir In FY 2009: Not Applicable.	Vs UAV systems requirements to raft. Perform feasibility studies ements study	0.000	0.795	0.000
(U) (U) (U) (U)	CONGRESSIONAL ADD: Modified F-22 Maintneance-Free Nickel Cadmium Airce In FY 2007: Not Applicable. In FY 2008: Develop modifications of the cell designs, materials and electronics in th battery for application in the F-16 aircraft. In FY 2009: Not Applicable.	raft Batteries for the F-16 he F-22 sealed Nickel-Cadmium	0.000	1.391	0.000
(U) (U) (U) (U)	CONGRESSIONAL ADD: THEMA- Thermal and Energy Management for Aerospa In FY 2007: Not Applicable. In FY 2008: Conduct research to advance the state of the art of thermal and energy m aerospace applications.	ace nanagement technologies for	0.000	3.477	0.000
(U) (U)	Total Cost		43.560	44.201	29.280
Pro	iect 3145 R-1 Line It Page-2	em No. 11 .4 of 35		Exhibit R-2a	(PE 0602203F)
	15 UNCLAS	58 SSIFIED			

	Exhibit R-2a, RDT&E Project Justification February 2008									
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER A 0602203F A	ND TITLE	pulsion	PROJECT NUMBER AND TITLE 3145 Aerospace Power Technology		
(U)	C. Other Program Funding Sum	<u>nary (\$ in Millio</u>	ons)							
		<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	FY 2010 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>	
(U) (U)	Related Activities: PE 0601102F, Defense Research Sciences.									
(U) (U)	PE 0602102F, Aerospace Flight Dynamics. PE 0602605F, Directed Energy									
(U)	Technology. PE 0602805F, Dual Use Science									
(U)	and Technology. PE 0603605F, Advanced Weapon Technology.									
(U)	PE 0603216F, Aerospace Propulsion and Power									
(U)	Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.									
(U)	D. Acquisition Strategy Not Applicable.									
Pro	oject 3145			R-1 Line Page	e Item No. 11 e-25 of 35				Exhibit R-2a (PE 0602203F)	
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	Exh	nibit R-2a, F	RDT&E Pro	oject Justifi	ication			DATE	February	2008
BUDG 02 A	ET ACTIVITY pplied Research			P 0	E NUMBER AND	o TITLE ospace Prop	ulsion	PROJECT NUME 33SP Space	BER AND TITLE Rocket Comp	oonent Tech
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
33SP	Space Rocket Component Tech	56.623	53.477	48.258	49.014	49.188	48.468	49.486	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Speed Propu Cycle (U)	Airbreathing Propulsion Technologies, to ilsion Technology, absorbed the efforts of a Engine (CCE) developments. A. Mission Description and Budget Item This project develops advances in rocket prof emphasis are propellants, propellant mar space propulsion concepts. Technologies of and missile launch subsystems. Technolog manufacturing techniques. All efforts in th Defense, NASA, and industry effort to focu interest to both the Department of Defense component development, and ground-based	this Project in on a thrust from Pre- Justification ropulsion technic agement, combined of interest will in ies are develop is project contrus rocket proputa and the NASA. I tests.	order to more e oject 33SP, Spa ologies for spac oustion, rocket mprove reliabil ed to reduce th ibute to the Inte lsion technolog Efforts incluce	effectively mana ace Rocket Cor ce access, space material applic lity, performand e weight and co egrated High Pa gy on national n de modeling and	age and provide mponent Techn e maneuver, tac cations, Techno ce, survivability ost of compone ayoff Rocket P needs. Technol- d simulation, p	e oversight of t ology, in order ctical and ballis logy for Sustai y, affordability nts using new 1 ropulsion Tech ogies develope roof of concept	he efforts. In I to more effect tic missiles. A nment of Strate , and environm naterials and in nology (IHPR) d under this pre- tests of critica	FY 2007, Project ively manage c analytical and e egic Systems (T eental compatib mproved design PT) program, a ogram enable c il components, a	ct 3012, Advan- ooperative Con xperimental are SSS), and nove ility of future sp is and joint Departme apabilities of advanced	ced nbined eas el pace ent of
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop, characterize and reduced-toxicity monopropellants to i synthesis methods. Efforts include evalua oxidizers, nano-materials, catalyst, and po determining optimized paths for incorpora laboratory and demonstrator engine evalua bipropellants that reduce the cost of space phases. In FY 2007: Downselected and scaled-up propellants in advanced combustion devic supporting large-scale motor tests. Comp	(\$ in Millions) e, and test advan ncrease space la ition and develo lymeric binders ting these mate ations. Efforts access and spa promising high es to determine leted scale-up o	nced hydrocarb aunch payload opment of reduces; development rials into prope seek monoprop ce operations. n energy-densit materials com f candidate ior	oons, energetics capability and ced-toxicity ior of supporting of ellants; and for pellants with pe Phases are refe ty materials can upatibility and p nic liquids. Exp	s, solid propella refine new prop nic salt, high-en computational selected propel erformance equi erring to the IH ndidates. Evalu performance to plored and deve	ant ingredients, pellants tools; llants perform ivalent to PRPT program tated scaled-up include eloped ionic	<u>FY</u>	<u>7 2007</u> 3.346	<u>FY 2008</u> 4.186	<u>FY 2009</u> 4.826
(U)	liquids. Advanced concepts work moved In FY 2008: Initiate evaluation and devel- kerosene. Continue downselect process at Develop new high engergy-density, high r	to another thrus opment of pote nd continue sca nitrogen ingredi	st. ntial hydrocarb ling-up promis ents. Develop	oon fuel additiv ing high energy proof of conce	es to improve p y-density mater ppt for new com	performance of ials candidates putational code	2			
Proje	ect 33SP			R-1 Line Iten Page-26	n No. 11 of 35				Exhibit R-2a (PE 0602203F)

	Exhibit R-2a, RDT&E Project Justif	ication	DA	TE February	2008
BUD(02 A	P pplied Research P	E NUMBER AND TITLE 602203F Aerospace Propulsion	PROJECT NU 33SP Space	JMBER AND TITLE	ponent Tech
(U)	B. Accomplishments/Planned Program (\$ in Millions) to predict molecular properties of propellant ingredients. Evaluate scaled-up propellan devices to determine materials compatibility and performance to include supporting lan Continue exploration and development of ionic liquids.	ts in advanced combustion ge-scale motor tests.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue evaluation and development of potential hydrocarbon fuel addit of kerosene. Continue downselect process and continue scaling-up promising high energy candidates. Continue development and characterization of high nitrogen ingredients. It in advanced combustion devices to determine materials compatibility and performance large-scale motor tests. Continue exploration and development of ionic liquids meeting scale up of promising ionic liquids for further characterization. Continue proof of cond code to predict molecular properties.	ives to improve performance ergy-density materials Evaluate scaled-up propellants to include supporting g Phase III goals. Initiate cept for new computational			
(U) (U)	MAJOR THRUST: Develop advanced liquid engine combustion technology for impropreserving chamber lifetime and reliability needs for engine uses in heavy lift space ve modeling and analyzing advanced propulsion concepts with enhanced performance and aerovehicles and potential launch systems.	oved performance, while hicles. Efforts include d reliability such as	7.647	7.909	7.239
(U)	In FY 2007: Characterized, studied, and evaluated shear coaxial injector performance compatibility and prevent damage to upper stage engines. Developed, analyzed, and tr combustion device technology, including injectors and chambers suitable for advanced capable of meeting or exceeding goals. Developed improved understanding of fundam flow/heat transfer processes leading to new methodologies for thermal management, so instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for conduct full-scale component and engine tests. Developed, scaled-up, and transitioned new end fuels and additives for rocket propulsion, including space storable high energy, non-tox validation and verification of advanced multi-phase modeling and simulation (M&S) c proof-of-concept measurements of promising advanced propulsion concepts. developed computational models of these concepts, and continued system trade studies to evaluate investment.	to ensure chamber/injector ransitioned advanced synthetic hydrocarbon fuels tental combustion and fluid caling, and combustion ting large numbers of costly ergetic advanced hydrocarbon scic fuels. Continued apabilities. Conducted ed more complex and realistic e potential return on			
(U)	In FY 2008: Characterize, study, and evaluate shear coaxial injector performance to en compatibility and prevent damage to upper stage engines. Develop, analyze, and trans device technology, including injectors and chambers suitable for advanced synthetic hy meeting or exceeding the Phase III goals. Develop improved understanding of fundam flow/heat transfer processes leading to new methodologies for thermal management, so	nsure chamber/injector ition advanced combustion ydrocarbon fuels capable of tental combustion and fluid caling, and combustion			
Pro	ect 33SP R-1 Line Iter Page-27	n No. 11 of 35		Exhibit R-2a (PE 0602203F)
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	Exhibit R-2a, RDT&E Project Ju	stification	DA	TE February	/ 2008
BUDO 02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NI 33SP Spa	JMBER AND TITLE	ponent Tech
(U)	B. Accomplishments/Planned Program (\$ in Millions) instabilities in hydrocarbon fueled liquid rocket engines, reducing the need for cor full-scale component and engine tests. Complete scale-up and transition new ener and additives for rocket propulsion, including space storable high energy, non-tox verification of advanced multi-phase M&S capabilities. Perform pre-selection of a propulsion concepts; apply realistic computational models to optimize performance experimental demonstrations of proof-of-concepts, continue development of realiss Continue system trade studies with improved performance models to evaluate pote	ducting large numbers of costly getic advanced hydrocarbon fuels c fuels. Conduct validation and nost promising advanced e. Continue and refine tic computational models. ential return on investment.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Characterize, study, and evaluate shear injector performance to ensure and prevent damage to engines. Develop, analyze, and transition advanced combu- injectors and chambers. Develop improved understanding of fundamental combus- processes leading to new methodologies for thermal management, scaling, and con- hydrocarbon fueled liquid rocket engines, reducing the need for conducting large a component and engine tests. Evaluate novel nozzle cooling channels for use with flux test rig. Conduct validation and verification of advanced M&S capabilities. I promising advanced propulsion concepts; apply realistic computational models to and refine experimental demonstrations of proof-of-concepts, continue developmed models. Continue system trade studies with improved performance models to eva- investment.	e chamber/injector compatibility stion device technology, including tion and fluid flow/heat transfer nbustion instabilities in numbers of costly full-scale hydrocarbon fuels in the high heat Perform pre-selection of most optimize performance. Continue nt of realistic computational luate potential return on			
(U)	MAJOR TURIET. Develop advanced material applications for lightweight comm	on onto and motorial moments.	5 757	6 0 1 9	6756
(U)	enhancements for use in advanced combustion devices and propulsion systems for propulsion systems. In FY 2007: Developed new advanced ablative components using hybrid polymet processing parameters of new nano-reinforced high temperature polymers and sca materials. Developed new advanced materials for use with high-energy propellant	current and future rocket s. Characterized and finalized e-up processing of carbon-carbon s. Explored using nanocomposites	5.257	0.048	0.750
(U)	for liquid rocket engine components and optimize processing technology using mu In FY 2008: Continue developing new advanced ablative components using hybric characterize and finalize processing parameters of new nano-reinforced high temp processing of carbon-carbon materials. Continue developing new advanced mater propellants. Continue to explore using nanocomposites for liquid rocket engine co processing technology using multifunctional nanomaterials. Evaluate new class of materials.	Itifunctional nanomaterials. d polymers. Continue to erature polymers and scale-up ials for use with high-energy omponents and optimize Thydrophobic and oleophobic			
	R-1 Lin	e Item No. 11		F (1 1 5 -	
Proj	Pag	9-28 of 35 162		Exhibit R-2a	(PE 0602203F)

BUDGET ACTIVITY PE NUMBER AND ITTLE 062203F Acrospace Propulsion PROJECT NUMBER AND ITTLE 33SP Space Rocket Component Tect 33SP Space Rocket Component Tect (U) B. Accomplishments/flamed Program (5 in Millions) EY 2002 EY 2003 EY 2009 In FY 2009: Continue developing new advanced ablative components using hybrid polymers. Continue to characterize and finalize processing parameters of new nano-trinforced high temperature polymers and scale-up processing of carbon-arrhor materials. Continue developing new advanced materials for use with high-energy propellams. Continue to explore using nanocomposites for liquid rocket engine components and optimize processing technology using multifunctional nanomaterials. Continue to thankers. Continue to thankers of the davance modeling and memorative and understand the mechanisms behind a new class of hydrophobic and exceptene to advanced cryogenic liquid rocket upper stage technologies. Developed advanced cryogenic upper stage technologies trubopumps and flust chambers. Evaluated third set op rotential hydrocarbon boest technology development for advanced cryogenic liquid rocket upper stage technologies. Developed advanced cryogenic upper stage technologies using the short hub there spacelift concepts. Initiate engine health monitoring engine technology development for dura space for fugure rocket upper stage technologies using the short house technology development for future spacelift concepts. Initiate engine health monitoring the hydrocarbon boost technology development effort. As on initiate discelopting hydrocarbon boost technology development effort. As on initiate discelopting hydrocarbon boost technology development effort. As on initiate discelopting hydrocarbon boost technology development effort. Bevelop advanced hydrocarbon boost technology development effort. Develop adv		Exhibit R-2a, RDT&E Project Justi	ication	DA	TE February	2008	
B. Accomplishments/Planued Program (\$ in Millions) FY 2007 FY 2008 FY 2008 (1) In FY 2009. Continue developing new advanced ablative components using hybrid polymers. Continue to characterize and finalize processing parameters of new nano-cariforced high temperature polymers and scale-up processing of carbon-carbon materials. Continue developing new advanced materials for use with high-emergy propellands. This continue to explore using nanocomposites for liquid coxet engine components and optimize processing technology using multifunctional nanomaterials. Continue to characterize and understand the mechanisms behind a new class of hydrophobic and deephobic materials. 24.374 22.331 23.646 (1) (1) MAIOR THRUST: Develop advanced itquid engine technologies for improved performance, while increasing life and reliability needs for optimum advanced cryogenic liquid nocket upper stage technologies. Developed advanced cryogenic upper stage technologies using fuscional to presso for liquid nocket upper stage technologies. Developed advance of progenic liquid nocket upper stage technologies. Continue enabling hydrocarbon boost technology development for future spacefil concepts. Started hydrocarbon boost technology development for future spacefil concepts. Started hydrocarbon boost technology development effort. Develop advanced hydrocarbon boost technology development effort. Develop advanced hydrocarbon boost technology development effort. Develop advanced hydrocarbon on prime technologies using fuels other than kerosene. 10 10 11 FY 2008 6.691 6.048 5.791 (1) In FY 2009. Continue enabling hydrocarbon boost technology development effort. Develop advanced	BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT N 33SP Spa	CT NUMBER AND TITLE Space Rocket Component Tech		
(U) MAJOR THRUST: Develop advanced liquid engine technologies for improved performance, while increasing life 24.374 22.331 23.646 and reliability needs for engine uses in expendable and reusable launch vehicles. In FY 2007: Conducted advance modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Developed advanced cryogenic upper stage technologies-turbopumps and thrust chambers. Evaluated third set of potential hydrocarbon fuels and adjust/modify/develop fuel character/aziton test rig. Completed development of second concept for lightweight nozzles for liquid rocket engines. Started hydrocarbon boost technology development for future spacelift concepts including materials scale-up efforts to improve life and weight of the liquid engine components. U) In FY 2008: Complete advance modeling and simulation tool development for davanced cryogenic liquid rocket upper stage technologies. Continue enabling hydrocarbon boost technology development for future spacelift concepts. Initiate engine health monitoring effort supporting the hydrocarbon boost technology development effort. Also initiate efforts developing hydrocarbon boost technology development effort. Also initiate efforts developing to the thank erosene. MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for stationkceping, repositioning, and orbit transfer for large communication statellites, microsatellites, microsatellites, monogroupellants. Initiated assessment of advanced chemical propulsion technology developments for satellites. 6.691 6.048 5.791 (U) In FY 2007: Conducted Hall thruster development efforts. Evaluated plasm	(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Continue developing new advanced ablative components using hybrid per characterize and finalize processing parameters of new nano-reinforced high temperate processing of carbon-carbon materials. Continue developing new advanced materials propellants. Continue to explore using nanocomposites for liquid rocket engine comp processing technology using multifunctional nanomaterials. Continue to characterize mechanisms behind a new class of hydrophobic and oleophobic materials.	olymers. Continue to ure polymers and scale-up for use with high-energy onents and optimize and understand the	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) MAJOR THRUST: Develop advanced liquid engine technologies for improved performance, while increasing life and reliability needs for engine uses in expendable and reusable launch vehicles. 22.331 23.646 (U) In FY 2007: Conducted advance modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Developed advanced cryogenic upper stage technologies-trobourphs and thrust chambers. Evaluated third set of potential hydrocarbon fuels and adjust/modelyde lec characterization test rig. Completed development for future spacelift concepts including materials scale-up efforts to improve life and weight of the liquid engine components. 23.646 (U) In FY 2008: Complete advance modeling and simulation tool development for advanced cryogenic liquid rocket upper stage technologies. Continue enabling hydrocarbon boost technology development. If or advanced cryogenic liquid rocket upper stage technologies. Continue enabling hydrocarbon boost technology development effort. Also initiate efforts developing hydrocarbon boost technology development effort. Also initiate efforts developing hydrocarbon boost technology development effort. Also initiate efforts developing hydrocarbon boost technology development effort. Develop advanced hydrocarbon loogies supporting the hydrocarbon boost technologies for stationkeeping, repositioning, and orbit transfer for large communication satellites, microsatellites, and satellite conset little truster development for strated plasma thrusters for microsatellites propulsion systems. Initiate diseauers tering to the IHPRPT program phases. 6.691 6.048 5.791 (U) In FY 2007: Conduced Hall thruster development efforts. Continue evaluating plasma thrusters for microsatellites propulsion systems. Initiated assessment of advanced multi-mod	(U)						
 (U) MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for 6.691 6.048 5.791 stationkeeping, repositioning, and orbit transfer for large communication satellites, microsatellites, and satellite constellations. Phases are referring to the IHPRPT program phases. (U) In FY 2007: Conducted Hall thruster development efforts. Evaluated plasma thrusters for microsatellites propulsion systems. Initiated scale-up testing monopropellants. Initiated assessment of advanced chemical propulsion technology developments for satellite thrusters. Initiated development of advanced multi-mode chemical-electric propulsion concepts for satellites. (U) In FY 2008: Continue Hall thruster development efforts. Continue evaluating plasma thrusters for microsatellites propulsion systems. Continue scale-up testing additional monopropellants. Continue assessment of advanced Project 33SP Ref. 2007 State R-2a (PE 0602203F) 	(U) (U) (U) (U)	MAJOR THRUST: Develop advanced liquid engine technologies for improved perfo and reliability needs for engine uses in expendable and reusable launch vehicles. In FY 2007: Conducted advance modeling and simulation tool development for advan upper stage technologies. Developed advanced cryogenic upper stage technologies-tu Evaluated third set of potential hydrocarbon fuels and adjust/modify/develop fuel chan Completed development of second concept for lightweight nozzles for liquid rocket en boost technology development for future spacelift concepts including materials scale-tweight of the liquid engine components. In FY 2008: Complete advance modeling and simulation tool development for advan upper stage technologies. Continue enabling hydrocarbon boost technology developm concepts. Initiate engine health monitoring effort supporting the hydrocarbon boost technologies using fuels other tha In FY 2009: Continue enabling hydrocarbon boost technology development for future engine health monitoring technologies supporting the hydrocarbon boost technology advanced hydrocarbon engine technology development for future engine health monitoring technologies using fuels other than kerosene.	rmance, while increasing life need cryogenic liquid rocket rbopumps and thrust chambers. racterization test rig. ngines. Started hydrocarbon up efforts to improve life and ced cryogenic liquid rocket nent for future spacelift echnology development effort. n kerosene. e spacelift concepts. Develop levelopment effort. Develop	24.374	22.331	23.646	
 (U) MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced propulsion technologies for 6.691 6.048 5.791 stationkeeping, repositioning, and orbit transfer for large communication satellites, microsatellites, and satellite constellations. Phases are referring to the IHPRPT program phases. (U) In FY 2007: Conducted Hall thruster development efforts. Evaluated plasma thrusters for microsatellites propulsion technology developments for satellite thrusters. Initiated assessment of advanced multi-mode chemical-electric propulsion concepts for satellites. (U) In FY 2008: Continue Hall thruster development efforts. Continue evaluating plasma thrusters for microsatellites propulsion systems. Continue scale-up testing additional monopropellants. Continue assessment of advanced R-1 Line Item No. 11 Project 33SP 	(U)						
 (U) In FY 2007: Conducted Hall thruster development efforts. Evaluated plasma thrusters for microsatellites propulsion systems. Initiated scale-up testing monopropellants. Initiated assessment of advanced chemical propulsion technology developments for satellite thrusters. Initiated development of advanced multi-mode chemical-electric propulsion concepts for satellites. (U) In FY 2008: Continue Hall thruster development efforts. Continue evaluating plasma thrusters for microsatellites propulsion systems. Continue scale-up testing additional monopropellants. Continue assessment of advanced Project 33SP 	(U)	MAJOR THRUST: Develop solar electric, solar thermal, chemical, and advanced prostationkeeping, repositioning, and orbit transfer for large communication satellites, mic constellations. Phases are referring to the IHPRPT program phases.	pulsion technologies for crosatellites, and satellite	6.691	6.048	5.791	
(U) In FY 2008: Continue Hall thruster development efforts. Continue evaluating plasma thrusters for microsatellites propulsion systems. Continue scale-up testing additional monopropellants. Continue assessment of advanced R-1 Line Item No. 11 Project 33SP Page-29 of 35 Exhibit R-2a (PE 0602203F)	(U)	In FY 2007: Conducted Hall thruster development efforts. Evaluated plasma thruster systems. Initiated scale-up testing monopropellants. Initiated assessment of advanced technology developments for satellite thrusters. Initiated development of advanced m propulsion concepts for satellites.	s for microsatellites propulsion l chemical propulsion ulti-mode chemical-electric				
R-1 Line Item No. 11Project 33SPPage-29 of 35Exhibit R-2a (PE 0602203F)	(U)	In FY 2008: Continue Hall thruster development efforts. Continue evaluating plasma propulsion systems. Continue scale-up testing additional monopropellants. Continue	thrusters for microsatellites assessment of advanced				
Project 33SP Page-29 of 35 Exhibit R-2a (PE 0602203F)		R-1 Line Ite	m No. 11				
	Pro	ect 33SP Page-29	of 35		Exhibit R-2a	(PE 0602203F)	

	Exhibit R-2a, RDT&E Project Justificatio	n	DA	TE February	2008
BUDO 02 A	GET ACTIVITYPE NUMEopplied Research060220	BER AND TITLE 3F Aerospace Propulsion	PROJECT N 33SP Spa	UMBER AND TITLE ce Rocket Com	ponent Tech
(U)	B. Accomplishments/Planned Program (\$ in Millions) chemical propulsion technology developments for satellite thrusters. Continue development of chemical-electric propulsion concepts for satellites. Initiate development of alternative propul associated modeling, simulation, and analysis tools to augment or replace Hall Thrusters in the	f advanced multi-mode sion concepts and e future.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue Hall thruster development efforts. Continue evaluating plasma thruster propulsion systems. Continue scale-up testing additional monopropellants, evaluate advanced chamber concepts. Continue assessment of advanced chemical propulsion technology develop thrusters, begin component developments. Continue development of advanced multi-mode ch propulsion concepts for satellites, down-select to single design concept, and begin component	rs for microsatellites ignition schemes and oments for satellite emical-electric developments.			
(U) (U)	MAJOR THRUST: Conduct assessments, design trades, and simulations to integrate combine (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies in support of the affordable, on-demand access to space vehicles to meet future warfighter needs. Note: In FY transferred within this PE to Project 623012, Advanced Propulsion Technologies, to consolida this cooperative CCE effort.	ed cycle engines development of 2008, this effort tte and better manage	0.478	0.000	0.000
(U)	In FY 2007: Conducted assessments, system design trades, and simulations to integrate comb (CCEs) and advanced cycle airbreathing hypersonic propulsion technologies in support of the affordable, on-demand access to space vehicles to meet future warfighter needs.	ined cycle engines development of			
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced Liquid Rocket Booster Technology. In FY 2007: Developed hydrocarbon boost rocket engine technologies for the Air Force. In FY 2008: Not Applicable. In FY 2009: Not Applicable.		1.374	0.000	0.000
(U) (U)	CONGRESSIONAL ADD: Engineering Tool Improvement Program (ETIP). Note: In FY 20 Engineering Tool Improvement Program (ETIP) and transferred from PE 0602500F, Multi-Di Technology, Project 5026, Rocket Propulsion Component Technology to better manage devel	07, this add was titled sciplinary Space	2.747	0.000	0.000
(U)	In FY 2007: Developed advanced rocket engine modeling, simulation, and analysis tools for j integrated them into seamless suite of tools for scientists and engineers to use in developing at technologies.	propulsion and lvanced propulsion			
(U)	In FY 2008: Not Applicable.				
Proj	R-1 Line Item No. 11 Page-30 of 35			Exhibit R-2a ((PE 0602203F)

	Exhibit R-2a, RDT&E Project Justific	DA	TE February	2008		
BUD(02 A	BET ACTIVITY PE	NUMBER AND TITLE 502203F Aerospace Propulsion	PROJECT N 33SP Spa	ECT NUMBER AND TITLE Space Rocket Component Tech		
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Not Applicable.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U)	CONGRESSIONAL ADD: Methane Second Stage Rocket Engine. In FY 2007: Developed liquid oxygen, liquid methane pressure fed second stage rocket Air Force.	engine technologies for the	1.570	0.995	0.000	
(U)	In FY 2008: Scale-up liquid oxygen, liquid methane pressure fed second stage rocket en Force.	ngine technologies for the Air				
(U) (U)	In FY 2009: Not Applicable.					
(U) (U)	CONGRESSIONAL ADD: Advanced Vehicle and Propulsion Center. In FY 2007: Performed technical support and analysis for the Prompt Global Strike Ana Conducted facility upgrades to support upcoming testing which support planning efforts Deterrent and Operationally Responsive Spacelift activities.	3.139	1.589	0.000		
(U)	In FY 2008: Refine analytical tools to help assess feasibility and cost benefit of using co across multiple launch platforms. Continue model developments that will support Promp ballistic missile development efforts.	ommon boosters/engines pt Global Strike and future				
(U)	In FY 2009: Not Applicable.					
(U) (U) (U)	CONGRESSIONAL ADD: Hydrocarbon Boost Technology Demonstrator. In FY 2007: Not Applicable.		0.000	1.193	0.000	
(U) (U)	In FY 2008: Funds will be used to accelerate development of technologies for highly op In FY 2009: Not Applicable.	perable and reusable spacelift.				
(U) (U)	CONGRESSIONAL ADD: Integrated Propulsion Analysis Tool (IPAT).		0.000	1.589	0.000	
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Increase fidelity of rocket engine analysis and assessment tools and broader concepts being considered by the Air Force.	n application to advanced				
(U) (U)	In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Development and Testing of Advanced Paraffin-Based Hyb Applications.	orid Rockets for Space	0.000	1.589	0.000	
(U)	In FY 2007: Not Applicable.					
Pro	ject 33SP R-1 Line Item Page-31 o	No. 11 f 35		Exhibit R-2a	(PE 0602203F)	

	Exhibit R-	2a, RDT&E	Project Ju	stification			DATE	February	/ 2008
BUDGET ACTIVITY 02 Applied Research				PE NUMBER A 0602203F A	ND TITLE erospace Pro	pulsion	PROJECT NUMBER AND TITLE 33SP Space Rocket Compone		
 (U) <u>B. Accomplishments/Planned</u> (U) In FY 2008: Scale-up of hybrid (U) In FY 2009: Not Applicable. 	Program (\$ in Mil rocket technologie	llions) s and characteriz	ze for potential	application to spa	ace applications.	I	<u>7Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Total Cost							56.623	53.477	48.258
(U) <u>C. Other Program Funding Su</u>	<u>ımmary (\$ in Milli</u>	<u>ons)</u>							
	<u>FY 2007</u>	<u>FY 2008</u> 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	Total Cost
(U) Not Applicable.	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
(U) <u>D. Acquisition Strategy</u> Not Applicable									
Project 33SP			R-1 Lin Pag	e Item No. 11 e-32 of 35				Exhibit R-2a	(PE 0602203F)
				166					
			UNCL	ASSIFIED					

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	cation			DATE	February	2008
BUDG 02 A	ET ACTIVITY pplied Research			PI 0	E NUMBER AND	TITLE ospace Prop	ulsion	PROJECT NUME 4847 Rocket	Technology	
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4847	Rocket Propulsion Technology	18.516	10.651	9.188	10.702	7.511	11.762	12.073	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U) <u>4</u> 6 1 1	A. Mission Description and Budget Item This project develops technologies for the sefforts). Technologies of interest will imprare being accomplished in two phases and a IJ/35 percent (Phase II) through the use of a prediction uncertainties for individual moto Sustainment of Strategic Systems program	Justification sustainment of s rove reliability, are developed to new materials ar ors by 50 percen and support the	trategic system performance, s reduce the we nd improving c it, enabling mo Integrated Hig	ns (including so ourvivability, af eight by 15 pero lesigns and man tor replacemen gh Payoff Rock	blid boost/missi fordability, and cent (Phase I)/2 nufacturing tec t for cause. Al cet Propulsion 7	ile propulsion, j l environmenta 20 percent (Pha hniques. Aging l efforts in this Fechnology pro	post boost com l compatibility se II) and cost g and surveilla project are par gram.	trol, aging and s of these system of components nce efforts coul rt of the Techno	surveillance ns. Technolog 25 percent (Ph d reduce lifetin logy for the	ies ase me
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop missile prop Efforts support the Technology for the Su 2008 and out due to post boost control sys	(\$ in Millions) pulsion and boos stainment of Str	at technologies ategic Systems technology m	for tactical and s program. Not aturation and e	l ballistic missi te: Decreased f	le systems. funding in FY ns.	<u>FY</u> 1	<u>7 2007</u> 1.611	<u>FY 2008</u> 8.201	<u>FY 2009</u> 4.962
(U)	 2008 and out due to post boost control system component technology maturation and effort completions. In FY 2007: Initiated component development and risk reduction efforts for the Missile Propulsion demonstration. Verified development of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles to enhance performance and weight. Demonstrated low-cost, high temperature, non-erosive, lightweight coated carbon-carbon, ceramic and hybrid polymer components for solid rocket motors. Developed advanced tactical propulsion technologies. Formulated and characterized new propellant formulations using new fuels and oxidizers developed over the last couple of years for the next phase of advanced solid propulsion. Conducted sub-scale tests to characterize and validate physics in rocket motor environments and incorporate into modeling and simulation tool developments for solid rocket motors to be used in developing components for the Missile Propulsion Demonstration 									
(U)	 J) In FY 2008: Continue component development and risk reduction efforts for the Missile Propulsion demonstration. Conduct sub-scale testing of rapid densification nozzle technology using improved strategic propellants for future ballistic missiles to enhance performance and weight. Continue demonstrating low-cost, high temperature, non-erosive, lightweight coated carbon-carbon, ceramic and hybrid polymer components for solid rocket motors. Complete modeling, simulation, and analysis tool development efforts. Continue development of advanced tactical propulsion technologies. 									
(U)	In FY 2009: Continue component develop Use physics based modeling, simulation, a verify suitability of those technologies for	pment and risk and analysis too use in Missile 1	reduction effor ls to design and Propulsion den	ts for the Missi d analyze sub-s nonstration. Co	le Propulsion c scale componer omplete verifica	lemonstration. nts to help ation				
Proje	ect 4847			R-1 Line Item Page-33 (n No. 11 of 35				Exhibit R-2a ((PE 0602203F)

	Exhibit R-2a, RDT&E Project Just	ification	DATE February 2008				
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602203F Aerospace Propulsion	PROJECT NU 4847 Rock	JMBER AND TITLE	Technology		
(U)	B. Accomplishments/Planned Program (\$ in Millions) development of rapid densification nozzle technology using improved strategic proper missiles to enhance performance and weight. Continue demonstrating low-cost, high lightweight coated carbon-carbon, ceramic and hybrid polymer components for solid development of advanced tactical propulsion technologies.	ellants for future ballistic temperature, non-erosive, rocket motors. Continue	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U) (U) (U)	MAJOR THRUST: Develop missile propulsion technologies and aging and surveillar missiles. Efforts support the Technology for the Sustainment of Strategic Systems pr In FY 2007: Conducted advanced service life prediction technology program develop advanced sensors that can be embedded or attached to solid rocket motors and the ag tools that can translate and integrate the sensor data into existing aging and surveillar In FY 2008: Continue advanced service life prediction technology program develop advanced sensors that can be embedded or attached to solid rocket motors and the ag tools that can translate and integrate the sensor data into existing aging and surveillar In FY 2008: Continue advanced service life prediction technology program develop advanced sensors that can be embedded or attached to solid rocket motors and the ag tools that can translate and integrate the sensor data into existing aging and surveillar In FY 2009: Complete advanced service life prediction technology program develop advanced sensors that can be embedded or attached to solid rocket motors and the ag tools that can translate and integrate the sensor data into existing aging and surveillar in FY 2009: Complete advanced service life prediction technology program develop advanced sensors that can be embedded or attached to solid rocket motors and the ag tools that can translate and integrate the sensor data into existing aging and surveillar integrate advanced aging and surveillance technologies into demonstrations to valida uncertaintigs and accurately model motor behavior.	ance technologies for ballistic rogram. ping and applying existing and ing and surveillance models and ice tool suite. Ing and applying existing and ing and surveillance models and ice tool suite. ing and applying existing and ing and surveillance models and ice tool suite. Begin efforts to te and verify efforts to reduce	3.275	2.450	4.226		
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Aerospace Lab Equipment Upgrade. In FY 2007: Upgraded/augmented existing university facilities/capabilities to train f In FY 2008: Not Applicable. In FY 2009: Not Applicable.	uture aerospace engineers.	0.981	0.000	0.000		
(U) (U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced Vortex Hybrid Propulsion System. In FY 2007: Developed small launch vehicle size engines that utilize vortex combus improved performance and/or operability. Tasks included developments in propellar engine designs. Engine concepts examined included LOx/Propane vortex cold-wall designs. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	tion processes to generate at storage tanks as well as the chamber as well as vortex hybrid	1.668	0.000	0.000		
Pro	ect 4847 R-1 Line It Page-3	em No. 11 4 of 35		Exhibit R-2a	(PE 0602203F)		
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	Exhibit R-2a, RDT&E Project Justification February 2008												
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER AND TITLE PRO 0602203F Aerospace Propulsion 484				ROJECT NUMBER AND TITLE 847 Rocket Propulsion Technology				
(U) (U) (U) (U)	B. Accomplishments/Planned Pro CONGRESSIONAL ADD: Solid In FY 2007: Developed technolog In FY 2008: Not Applicable. In FY 2009: Not Applicable	ogram (\$ in Mil Boost Propulsio ies that aid in the	l <u>lions)</u> n Technology fo e sustainment of	or the Sustainme f strategic solid	ent of Strategic S rocket motors.	ystems.	Ē	<u>Y 2007</u> 0.981	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000			
(U)	Total Cost							18.516	10.651	9.188			
(U)	C. Other Program Funding Summ	<u>nary (\$ in Milli</u>	<u>ons)</u>										
		<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> 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>	<u>Total Cost</u>			
(U) (U) (U) (U) (U) (U) (U)	Related Activities: PE 0601102F, Defense Research Sciences. PE 0602114N, Power Projection Applied Research. PE 0602303A, Missile Technology. PE 0602500F, Multi-Disciplinary Space Tech. PE 0603311F, Ballistic Missile Technology. PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate												
(U)	duplication. D. Acquisition Strategy Not Applicable.												
Pro	ject 4847			R-1 Line Page	e Item No. 11 e-35 of 35				Exhibit R-2a ((PE 0602203F)			
					169					· · · · · · · · · · · · · · · · · · ·			

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PE NUMBER: 0602204F PE TITLE: Aerospace Sensors

	Exhibit R-2, RDT&E Budget Item Justification									2008
BUDGET 02 Apr	ACTIVITY blied Research	P' 0	E NUMBER AND	TITLE ospace Sens	ors					
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ III withous)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	130.517	121.242	109.048	104.557	112.890	112.671	115.159	Continuing	TBD
2002	Electronic Component Technology	25.409	24.922	26.489	25.731	29.486	38.475	39.034	Continuing	TBD
2003	EO Sensors & Countermeasures Tech	21.668	26.503	16.539	14.959	15.893	22.300	22.850	Continuing	TBD
44SP	Space Sensors	8.644	10.176	8.914	9.537	10.177	9.723	9.967	Continuing	TBD
4916	Electromagnetic Tech	21.064	14.217	15.929	14.639	13.889	0.000	0.000	Continuing	TBD
6095	Sensor Fusion Technology	20.262	19.801	18.348	16.144	17.448	17.609	18.008	Continuing	TBD
7622	RF Sensors & Countermeasures Tech	33.470	25.623	22.829	23.547	25.997	24.564	25.300	Continuing	TBD

Note: In FY 2007, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 5028, Space Sensors, Photonics and RF Processors, and Project 5029, Space Sensor and CM Technology, to Project 44SP, Space Sensors, in order to more effectively manage and provide oversight of the efforts. In FY 2012, efforts in Project 4916, Electromagnetic Technology, will transfer to Project 2002, Electronic Component Technology, and Project 2003, EO Sensors & Countermeasures Technology, as a result of Base Realignment And Closure law.

(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) radio frequency antennas and associated electronics for airborne and space surveillance, together with active and passive electro-optical sensors; 4) technologies to manage and fuse on-board sensor information for timely, comprehensive situational awareness; and 5) technology for reliable, all-weather surveillance, reconnaissance, and precision strike radio frequency sensors and electronic combat systems. Note: In FY 2008, Congress added \$5.0 million for the Super-Resolution Sensor System; \$3.2 million for the Optically Pumped Atomic Laser; \$2.4 million for the Low Voltage, Wideband Electro-Optic Polymer Modulator; \$1.0 million for the Center for Advanced Sensor and Communication Antennas; \$0.8 million for Optikey Optical Maximum Entropy Verification; and \$1.6 million for Sensor Fusion. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary sensor, electronics, and electronic combat technologies.

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Page-1 of 31	Exhibit R-2 (PE 0602204F)
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	Exhibit R-2, RDT&E B	Budget Item Justification		DATE Februa	DATE February 2008		
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	6	•	•		
(U)	B. Program Change Summary (\$ in Millions)						
		FY	2007	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	Previous President's Budget	13	3.235	108.055	103.739		
(U)	Current PBR/President's Budget	13	0.517	121.242	109.048		
(U)	Total Adjustments	-	2.718	13.187			
(U)	Congressional Program Reductions			-0.043			
	Congressional Rescissions			-0.770			
	Congressional Increases			14.000			
	Reprogrammings	-	1.220				
	SBIR/STTR Transfer	-	1.498				
(U)	Significant Program Changes:						
	Not Applicable.						
	C. Performance Metrics						
	Under Development.						
		R-1 Line Item No. 12					
		Page-2 of 31		Exhibit F	R-2 (PE 0602204F)		
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	Ext	nibit R-2a, F	RDT&E Pro	oject Justifi	ication				DATE	February	2008
BUDGI 02 A ¢	ET ACTIVITY oplied Research			P 0	YE NUMBER AND 1602204F Aero	TITLE ospace Sens	ors	PROJEC 2002 E Techno	DJECT NUMBER AND TITLE D2 Electronic Component Chnology		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2	.013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estin	nate	Complete	
2002	Electronic Component Technology	25.409	24.922	26.489	25.731	29.486	38.475		39.034	Continuing	TBD
Matai	Quantity of RDT&E Articles		<u>0</u>		0	0	0	d Classe	0		
(U) <u>4</u> T t t t t t t t t t t t t	A. Mission Description and Budget Item This project focuses on generating, control technologies developed under this project v capabilities. The technologies developed in photonic components; high-temperature electronic ele	Justification ling, receiving, will be used for nclude: explorate ectronics; signal ed mode integrate t also designs, d rate significantly e device and cor ems requirement	and processing intelligence, su cory device cor control and di ted circuits; re evelops, fabric y improved mi nponent techno s in the areas o	g electronic sign urveillance, rec ncepts, solid sta istribution; sign econfigurable el cates, and evalu litary sensors o ology developm of radar, comm	nals for radio-fr onnaissance, el- ate power device nal processing; i lectronics; powe tates techniques of smaller size, 1 nents under this unications, elec	requency sensor ectronic warfar es and amplifie multi-function er distribution; for integrating ower weight, le project are mil tronic warfare,	r aerospace ap e, battlespace rs; low noise a monolithic int multi-chip mo combinations ower cost, low litary unique; navigation, an	plication access, a and signa egrated c odules; an of these er power they are l and smart	s. The ind prec il contro ircuits; nd high electro dissipa pased of weapor	enabling sision engagem ol components; high-speed density packag nic component ation, higher n Air Force and ns.	ent ;ing 1
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop compact, af communications, Global Positioning Syst sensors. Develop advanced aperture subs efficient wideband multi-function sensors exciter subsystem technologies that enable warfare systems. Develop metamaterials greater emphasis on metamaterials.	(\$ in Millions) fordable, multi- em, radar, electr ystems that sup for radar, electr e compact, affor for conformal a	function receiv ronic warfare, port affordable ronic warfare, rdable, multi-fu rrays. Note:	ver, exciter, and intelligence, su and scalable a and communica unction, multi-h In FY 2009, th	l phased array c rveillance, and ntenna arrays as ations. Develop beam radar and his increase in fu	components for reconnaissance s well as enable p receiver and electronic unding is due to		<u>7 2007</u> 7.585		<u>FY 2008</u> 4.811	<u>FY 2009</u> 11.434
(U)	In FY 2007: Developed scalable panel de and demonstrated a distributed receiver/er electronic warfare sensors for intelligence	emonstration wi xciter architectu 2. surveillance. r	th multiple par re for advance econnaissance	nel communicat d multifunction , and battlespac	tion and metrolo n systems used i ce access capabi	ogy. Designed in radar and ilities.					
(U)	In FY 2008: Develop integrated wideban architecture for future multi-intelligence e distributed receiver/exciter architecture for sensors.	d multi-channel electronic warfa or advanced mul	phased array s re and radar ap ti-function sys	sub-array with opplications. Fin terms used in ra	digital receiver hish demonstration hadar and electron	and exciter ion of nic warfare					
(U)	In FY 2009: Demonstrate integrated wide applications. Design and develop digital	eband subarray	for future mult nents to enable	i-intelligence e full digital rec	electronic warfar	re and radar er capabilities					
Proje	act 2002			R-1 Line Iten Page-3 c	m No. 12 of 31					Exhibit R-2a (F	PE 0602204F)

	Exhibit R-2a, RDT&E Project Justi	fication	D/	February	/ 2008
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT N 2002 Elec Technolo	UMBER AND TITLE tronic Compon gy	ent
(U)	B. Accomplishments/Planned Program (\$ in Millions) per transmit/receive site to enable future software-controlled phased arrays. Develop emerging metamaterials for compact radiating sensor applications including conform electronics based upon complex media. Evaluate the potential for highly-integrated et low electromagnetic interference integrated devices and circuits through the use of m three-dimensional electronic building blocks including laboratory prototyping of elect radiating elements.	new hardware to exploit al array antennas and electronics and apertures using etamaterials as trically small, compact	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	MAJOR THRUST: Develop new microelectronic component technologies for radar, communications to support intelligence, surveillance, reconnaissance, precision strike capabilities using advances in material research and microelectronic fabrication techn In FY 2007: Demonstrated integrated photonic microsystems. Developed electronic techniques. Developed high performance radio-frequency circuits on lightweight and advanced semiconducting materials and devices	electronic warfare, and e, and battlespace access niques. s modeling and assessment I flexible substrates using	3.776	6.378	2.692
(U)	In FY 2008: Fabricate and perform lab testing to investigate physical and chemical properating conditions to understand operating lifetime-limiting changes in structure. Content electronics modeling and assessment techniques. Develop flexible and visually-transferences. In FY 2009: Continue fabrication and lab testing to investigate physical and chemical properties.	properties of microcircuits under Continue development of parent radio-frequency			
	to develop models to predict failure modes and lifetimes. Further refine electronics n techniques. Demonstrate flexible and visually-transparent radio-frequency electronic	nodeling and assessment			
(U) (U)	MAJOR THRUST: Develop integration and assembly technologies for high-perform sensors. Design and model photonic component technologies for radio-frequency dis Develop electro-optical devices for next-generation warfighter applications	nance aerospace phased array stribution and signal processing.	3.913	3.251	4.699
(U)	In FY 2007: Designed and developed radio-frequency modulation components to en- radio-frequency links and arbitrary electro-optical waveform generation. Initiated de cavity surface emitting lasers as compact, efficient, high-brightness sources. Initiated and optical components for high-power mid-infrared applications	able low-loss wideband velopment of vertical external 1 development of fiber-optics			
(U)	In FY 2008: Demonstrate photonic radio-frequency modulation components for radi electro-optical waveform generation. Continue development of vertical external cavi compact, efficient, high-brightness sources. Continue development of fiber-optics an	o-frequency links and arbitrary ty surface emitting lasers as d optical components for			
Proj	ect 2002 R-1 Line It Page-2 17	em No. 12 4 of 31		Exhibit R-2a	(PE 0602204F)
	Exhibit R-2a, RDT&E Project Justif	ication	DA	TE February	/ 2008
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BUD(02 A	ET ACTIVITY P pplied Research 0	PE NUMBER AND TITLE 1602204F Aerospace Sensors	PROJECT N 2002 Elec Technolog	UMBER AND TITLE tronic Compon gy	ent
(U)	B. Accomplishments/Planned Program (\$ in Millions) high-power mid-infrared applications.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue development of vertical external cavity surface emitting lasers a high-brightness sources. Complete development of fiber-optics and optical component applications. Develop ultra-stable, tunable, mode-locked lasers to enable highly integring eneration.	as compact, efficient, ts for high-power mid-infrared rated optical waveform			
(U) (U)	MAJOR THRUST: Develop signal control and low power consumption components a power loss and power consumption for future radar, electronic warfare, and intelligence reconnaissance sensors. Develop and integrate adaptable circuit technologies which ut low-loss signal control for multi-function radar and electronic warfare sensors used for reconnaissance, and battlespace access capabilities. Develop wideband (multi-octave) multi-function radio frequency apertures used in radar and electronic warfare sensor systems.	and techniques to reduce both e, surveillance, and tilize dynamic elements and intelligence, surveillance, component technologies for ystems.	4.714	3.820	5.388
(U)	In FY 2007: Developed and demonstrated adaptable microcircuits for multi-function a and transitioned reliable wideband power amplifiers for multifunction radar and electro applications. Characterized high-reliability Gallium Nitride-based circuits for millime applications.	applications. Characterized onic warfare sensor ter-wave and Q-band			
(U)	In FY 2008: Develop and demonstrate adaptable microcircuits for multi-function sens electronic approaches for energy-starved circuit applications.	ors. Emphasize emerging			
(U)	In FY 2009: Develop tunable and reconfigurable wideband amplifiers for use in multi- warfare sensors. Emphasize emerging electronics approaches for energy-starved circu	-function radar and electronic it applications.			
(U) (U)	MAJOR THRUST: Refine materials and processes for two-dimensional and three-dim and component protection from the environment. Develop and demonstrate innovative technology that lowers system cost through reduction of design costs, part count, chip integration costs.	nensional device interconnects e radio-frequency component size, production costs, and	1.977	3.331	1.138
(U)	In FY 2007: Designed and implemented military-specific radio-frequency components techniques and the latest commercial foundry advances. Characterized and performed respect to traditional radio-frequency component technologies.	s using advanced circuit design trade-space analysis with			
(U)	In FY 2008: Investigate microcircuit integration modeling and simulation tools to enal three-dimensional electronics.	ble two-dimensional and			
(U)	In FY 2009: Develop and demonstrate highly integrated phase control components for	use in wideband			
Proj	ect 2002 R-1 Line Iter Page-5 of Arrows	n No. 12 of 31		Exhibit R-2a	(PE 0602204F)

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008	
BUD(02 A	GET ACTIVITY pplied Research				PE NUMBER A 0602204F A	ND TITLE erospace Sen	sors	PROJECT NUM 2002 Electro Technology	BER AND TITLE	E nent	
(U)	<u>B. Accomplishments/Planned Pr</u> multi-function sensors.	<u>rogram (\$ in Mil</u>	<u>lions)</u>				I	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Evaluate the environment for mixed-signal (dig and emerging electronic compone	integrated tool su gital, radio-freque	ite in the model ncy, microwave	ing, simulation, e, etc.) componen	design, and char nt development i	acterization in both advanced	1	2.049	3.331	1.138	
(U)	In FY 2007: Designed and model	ed next-generatio	n wideband gap	devices for high	h power, high te	mperature, and					
(U)	In FY 2008: Continue design and under extreme conditions and ena	s. l refinement of mo ble multi-functior	odels for next-g	eneration high-p	ower componen	ts that operate					
(U)	In FY 2009: Demonstrate closed- fabrication, and characterization v	loop characteriza	tion of performation	ance-driven com	ponent and devi	ce design,					
(U) (U) (U)	CONGRESSIONAL ADD: 3-D I In FY 2007: Conducted Congres Communications.	NGRESSIONAL ADD: 3-D Packaging Technology for High Speed RF Communications. 1.395 FY 2007: Conducted Congressionally-directed effort for 3-D Packaging Technology for High Speed RF mmunications.									
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable. Total Cost							25.409	24.922	26.489	
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u>	ons)								
		FY 2007 Actual	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)	Related Activities: PE 0602500F, Multi-Disciplinary Space Technology.										
(U)	PE 0603203F, Advanced										
(U)	PE 0603270F, Electronic Combat Technology										
(U)	This project has been coordinated through the										
Proj	ect 2002			R-1 Line Page	Item No. 12 e-6 of 31				Exhibit R-2a ((PE 0602204F)	

Exhibit R-2a, RDT&E P	roject Justification	DATE February 2008
3UDGET ACTIVITY J2 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 2002 Electronic Component Technology
U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
Reliance 21 process to harmonize efforts and eliminate duplication.		
U) D. Acquisition Strategy Not Applicable.		
	R-1 Line Item No. 12	
Project 2002	Page-7 of 31	Exhibit R-2a (PE 060220

	Exh	nibit R-2a, F	DT&E Pro	ject Justifi	ication			DATE	February	2008		
BUDGE 02 Ap	DGET ACTIVITY Applied Research					PE NUMBER AND TITLE PRO. 0602204F Aerospace Sensors 200 Tec				ROJECT NUMBER AND TITLE 003 EO Sensors & Countermeasures ech		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total		
	ActualEstimateEsti3EO Sensors & Countermeasures Tech21.66826.503Quantity of RDT&E Articles00			Estimate	Estimate	Estimate	Estimate	Estimate	Complete			
2003	EO Sensors & Countermeasures Tech	21.668	26.503	16.539	14.959	15.893	22.300	22.850	Continuing	TBD		
	Quantity of RDT&E Articles	0	0	0	0	0	0	0				
T to d tu h a	This project determines the technical feasible echnologies under development range from igital processing, analysis tools, and senso racking, and identification of non-cooperat yperspectral imaging sensors and algorithm nd targeting. Other project goals include a	bility of advance in the ultraviolet or architectures. tive and difficul ms needed to er advanced electro	ed electro-optic through the in One of the pro t targets, such able precision p-optical threat	al aerospace se frared portion o ject's main goa as those obscur targeting in se t warning and c	ensor technolog of the spectrum als is to improve red by camoufla vere weather. T countermeasure	ies for a variet . Related effort e electro-optica age. This projec hese technolog s.	y of offensive a s include impr l and related te ct also develop ies are critical	and defensive u rovements in av echnologies for os the passive an to future aerosp	ses. The senso ionics integrati the detection, ad active pace surveilland	r on, ce		
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop technology f ground-based targets. In FY 2007: Performed off-board cued gr identification systems with multi-spectral, interrogation for combat identification inc hybrid focal planes and read-out electronic demonstration of electro-optical and infran- types for deep penetration and continuous In FY 2008: Perform phenomenology extr	(\$ in Millions) for non-cooperation- cound- and air-bipolarization-balluding three-dir cs capable of sin red system arch area coverage.	tive detection a ased testing an used target re-ac nensional imag nultaneous mu itectures for lay	and identification d demonstration cquisition and a ging and vibration lti-discriminan yered sensing b nt active/passive	on of airborne a on of advanced o active electro-o ion sensing. De t sensing. Beg based on multip	and combat ptical eveloped an le platform perform sensor	<u>FY</u>	2.720	<u>FY 2008</u> 2.386	<u>FY 2009</u> 2.884		
(U)	concept modeling. Collect signature data and polarimetric sensing techniques. Char performing identification of gaseous targe simultaneous multi-discriminant active and data enhancement.	for target discri racterize the per ts. Demonstrat d passive sensir	mination and s formance of a e hybrid focal j ng, and develop	hape extraction long-wave hyp planes and read o image process	n using passive perspectral sense l-out electronice sing techniques	multispectral or for s for for sensor						
(U)	In FY 2009: Perform sensor concept dem expected system performance. Characteri multispectral and polarimetric sensing tech electronics for simultaneous multi-discrim for sensor data enhancement. Perform trac techniques, including polarimetric discrim	onstrations for f ze target discrir hniques. Contin inant active and de-off studies for ination and syn	nulti-discrimir nination and sh nue demonstrat l passive sensit or long range ta thetic aperture	nant active and hape extraction ion of hybrid for ng, and refine i arget identificat laser radar.	passive sensing performance un ocal planes and mage processin tion using passi	g and quantify sing passive read-out g techniques ve and active						
Proje	ct 2003			R-1 Line Item Page-8 o 178	n No. 12 of 31				Exhibit R-2a (PE 0602204F)		

	Exhibit R-2a, RDT&E Projec	ct Justification	D	February	/ 2008	
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT N 2003 EO S Tech	UMBER AND TITLE Sensors & Cou	IMBER AND TITLE ensors & Countermeasures	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	FY 2009	
(U) (U)	MAJOR THRUST: Develop optical transmitter technology capable of sens robust non-cooperative target identification.	ing multiple target characteristics for	7.185	6.702	5.307	
(U)	In FY 2007: Continued development and testing of optical transmitter techn sensing multiple target characteristics for robust non-cooperative target ider field tests and utility analysis of multi-function pulsed vibration sensing and performance for long-range combat identification. Performed flight data co vibration combat identification sensor. Completed testing of breadboard ac evaluated performance for both hard and extended targets. Continued flight brassboard sensor development. Utilized flight test platform to support test air-to-ground systems under development. Continued collection of simultar sensing phenomenology data in airborne environment for difficult target det background characterization.	nologies including waveforms capable of ntification. Continued laboratory and d imaging system and evaluated ollections for pulsed gated imager and tive multi-spectral transmitter and t-capable, long-range, multi-function ing of long range air-to-air and neous passive and multifunction active tection analysis including diverse				
(U)	In FY 2008: Extend development and testing of optical transmitter technologidentification to increased standoff ranges. Explore optical discriminants for shape, polarization, and vibration using real-beam and synthetic aperture set aperture testbed supporting spatial synthesis imaging. Develop advanced m sensor trade studies with both active and passive sensors. Perform tower an modeling results. Explore enabling sensor components to support extended	ogies for non-cooperative target or long range identification including nsing techniques. develop a sparse nodels to support phenomenology-driven ad flight collections to validate system range operation.				
(U)	In FY 2009: Continue development and testing of optical transmitter techno- identification at long standoff ranges. Perform multi-function signature coll- including shape, polarization, and vibration using real-beam and synthetic a optimal system concepts using advanced active and passive sensor models. quantify expected performance. Develop enabling sensor components for a	ologies for non-cooperative target lections for long-range identification perture sensing techniques. Develop Continue tower and flight collections to long-range demonstration system.				
(U) (U)	MAJOR THRUST: Develop innovative techniques and components to targ	et difficult objects in battlefield	3.465	3.679	4.725	
(U)	In FY 2007: Continued development and began demonstration of technique objects in degraded atmospheric conditions. Integrated and evaluated weath into system-level tests. Demonstrated utility of non-mechanical beam steern applications including precision pointing, focusing, and wavefront correction	es and components to target difficult her and obscurant penetration concepts ing for advanced multimode sensor on. Continued development and				
Proj	ect 2003	R-1 Line Item No. 12 Page-9 of 31		Exhibit R-2a	(PE 0602204F)	

	Exhibit R-2a, RDT&E Project Justi	fication	DA	TE February	/ 2008	
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT N 2003 EO S Tech	NUMBER AND TITLE Sensors & Countermeasures		
(U)	B. Accomplishments/Planned Program (\$ in Millions) demonstrations of combined electro-optical/radio-frequency apertures including prelit Continued analysis and evaluation of specialized multifunction laser radar for detection difficult targets. Explored implementation of advanced architectures for advanced elec- vehicle-based systems to find, fix and identify difficult targets in difficult environment environment. Incorporated advanced passive and multifunction active sensing methor and background phenomenologies. Continued target phenomenology investigations.	minary sensor configurations. on and characterization of ectro-optical unmanned aerial ats including the urban ds to exploit all salient target	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Extend development of techniques for targeting difficult objects in dyna Develop passive infrared components and techniques for continuous surveillance of b tracking of dynamic targets and events. Continue development of non-mechanical be and active sensors. Explore passive and active laser detection and range-sensing pher capturing robust spectral, spatial, polarimetric, and radiometric signatures for moving association in dense target areas.	mic urban environments. road areas with detection and am steering for both passive nomenology techniques for target identification and track				
(U)	In FY 2009: Continue development of techniques for targeting difficult objects in dy. Perform concept demonstrations of continuous passive infrared surveillance of broad tracking of dynamic targets and events. Develop sensor concept designs for optimizin design trade-off experiments. Develop concepts for close-in sensing from unmanned unmanned aerial vehicles in difficult environments. Investigate small unmanned aeria non-mechanical beam steering for pointing and stabilization. Perform spectral, spatia signature collection experiments using laboratory passive and active laser detection an target identification and track association in dense target areas.	namic urban environments. areas with detection and ng revisit rate and perform aerial vehicles or small al vehicle applications of 1, polarimetric, and radiometric nd ranging sensors for moving				
(U) (U)	MAJOR THRUST: Develop countermeasure technologies for use against infrared- a	nd electro-optical guided	1.941	2.646	2.893	
(U)	In FY 2007: Continued evaluation of countermeasure techniques to defeat first-gener seekers. Initiated development of second-generation infrared imaging missile seeker countermeasure technique development. Continued exploitation of advanced infrared acquisition sensors for countermeasure technique updates and refinement. Conducted active-sensing technology to evaluate capabilities against multi-band infrared sensors	ration infrared-imaging missile models and simulations for missiles and infrared l laboratory assessments of				
(U)	In FY 2008: Continue development of second-generation infrared-imaging missile set for countermeasure technique development. Continue exploitation of advanced infrar acquisition sensors for countermeasure technique updates and refinement. Initiate ide	eker models and simulations red missiles and infrared entification of discriminants for				
Proj	ect 2003 R-1 Line Ite Page-10 18	em No. 12) of 31 Ο		Exhibit R-2a	(PE 0602204F)	

	Exhibit R-2a, RDT&E Project Just	DA	DATE February 2008			
BUDO 02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT N 2003 EO S Tech	CT NUMBER AND TITLE EO Sensors & Countermeasures		
(U)	B. Accomplishments/Planned Program (\$ in Millions) specific identification of new electro-optical sensors and missile threats.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Evaluate countermeasure techniques to defeat second-generation infrar Develop new countermeasure technique updates and refinement applicable to legacy identification of discriminants for specific identification of new electro-optical sense	ed-imaging missile seekers. 7 systems. Continue ors and missile threats.				
(U) (U)	MAJOR THRUST: Develop percentee missile and laser warning technologies to ac	curately cue countermeasures	0.679	0.557	0.730	
(U) (U)	In FY 2007: Continued developing laser warning sensor concepts for unmanned aer goggles. Continued developing new laser warning sensor technologies to address ul threats. Initiated development of an advanced laser warning concept for integration	ial vehicles and night vision tra-short and tunable laser into tactical aircraft.	0.079	0.337	0.750	
(U)	In FY 2008: Continue developing new laser warning sensor technologies to address threats. Identify methods to increase focal plane array dynamic range for precise chahigh-power laser threats.	ultra-short and tunable laser aracterization of low- and				
(U)	In FY 2009: Continue developing new laser warning sensor technologies to address threats. Identify clutter suppression techniques to increase signal to noise and improperations. Evaluate algorithms to optimize detection and declaration ranges.	ultra-short and tunable laser ve detection ranges in urban				
(U)						
(U)	CONGRESSIONAL ADD: WBI LADAR Development and Demonstration		1.992	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for WBI LADAR Develop	nent and Demonstration.				
(\mathbf{U})	In FY 2008: Not Applicable					
(0)	In F1 2009. Not Applicable.					
(U)	CONGRESSIONAL ADD: Super-Resolution Sensor System.		1.694	4.968	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for the Super-Resolution Se	ensor System.				
(U)	In FY 2008: Conduct Congressionally-directed effort for the Super-Resolution Sense	or System.				
(U) (U)	In FY 2009: Not Applicable.					
(U)	CONGRESSSIONAL ADD: Optically Pumped Atomic Laser (OPAL).		1.992	3.180	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for the OPAL.					
(U)	In FY 2008: Conduct Congressionally-directed effort for the OPAL.					
(U) (U)	In FY 2009: Not Applicable.					
Proi	R-1 Line I	tem No. 12		Exhibit P-22	(PE 0602204E)	
FIU		81		EXHIDIL R-24	(FE 0002204F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DAT	E February	2008		
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER A 0602204F A	PE NUMBER AND TITLEPROJE0602204F Aerospace Sensors2003Tech				ECT NUMBER AND TITLE EO Sensors & Countermeasures		
(U) (U) (U) (U) (U)	 B. Accomplishments/Planned Program (\$ in Millions) CONGRESSIONAL ADD: Low Voltage, Wideband Electro-Optic Polymer Modulator In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for the Low Voltage, Wideband Electro-Optic Polymer Modulator. In FY 2009: Not Applicable. 								<u>FY 2008</u> 2.385	<u>FY 2009</u> 0.000		
(\mathbf{U})								21.008	20.303	10.339		
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602500F, Multi-Disciplinary Space Technology. PE 0603253F, Advanced Sensor Integration. PE 0602301E, Intelligence System Program. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	mary (\$ in Milli <u>FY 2007</u> <u>Actual</u>	<u>ons)</u> <u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> <u>Estimate</u>	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>		
Pro	ject 2003			R-1 Line Page	e Item No. 12 9-12 of 31 182				Exhibit R-2a	(PE 0602204F)		
				UNCL	ASSIFIED							

	Ex	hibit R-2a, I	RDT&E Pro	ject Justifi	cation			DATE	February	2008
budo 02 A	GET ACTIVITY Applied Research			P 0	E NUMBER AND	o TITLE ospace Sens	sors	PROJECT NUM 44SP Space	BER AND TITLE Sensors	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
44S	P Space Sensors	8.644	10.176	8.914	9.537	10.177	9.723	9.967	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Note 5029	: In FY 2007, efforts were transferred from , Space Sensor and CM Technology, in ord	h PE 0602500F, ler to more effec	Multi-Discipli tively manage	nary Space Tec and provide ov	chnology, Proje rersight of the e	ect 5028, Space efforts.	Sensors, Photo	onics, and RF I	Processors and	Project
(U)	A. Mission Description and Budget Item	<u>n Justification</u>								
	(mixed) signals for radio-frequency space warfare, and precision engagement sensors information fusion for timely and compreh innovative electromagnetic and electronic smaller size, lower weight, lower cost, low multi-dimensional adaptive techniques in t	sensor applicati s based in space nensive commun countermeasure ver power dissip radar technology	ons. The enables. This project of the control of th	ing technologic levelops the ba tuational aware lications. This liability, and ir and reliable sp	seline technolo seline technolo project aims to nproved perfor pace surveillance	for intelligence ogies required t modeling and demonstrate s mance. This p ce and reconna	e, surveillance, o manage and simulation, thi significantly im roject also dev issance system	reconnaissance perform on-boa s project devel- proved militar elops and asses s.	e, electronic ard space sensor ops and evaluat y space sensors sses	r tes of
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop hybrid space Investigate hardware and software implete difficult targets from space. Develop space operating in jamming environments while 2007, space-based sensor platform technologies were placed here to show emphasis.	(\$ in Millions) re-based sensor : nentation appro ce-qualified pre e enabling multi plogy efforts, pre	solutions and re aches for the ne cision time, po ple-platform se eviously perfor	educe associate eeds of respons sition, and velo ensor-to-warfig med under othe	d technology ri ive space and co ocity sensors ca hter operations er major thrusts	isks. of sensing pable of . Note: In FY s in the project,	<u>Fy</u>	<u>7 2007</u> 3.878	<u>FY 2008</u> 3.102	<u>FY 2009</u> 2.965
(U) (U)	In FY 2007: Initiated identification and c capabilities of space-based sensor platfor In FY 2008: Define specific responsives	levelopment of ms.	specific technic ctional capabil	ues and techno ities and impler	blogies to furthe mentation asses	er expand the ssments.				
	Model size-, weight-, and power-restricte applications. Develop a constructive syst in terms of measures of performance and	d precision time ems engineering warfighter utilit	e, position, and g model to asse	velocity sensor ss space-based	r techniques for assured referen	r space-based nce techniques				
(U)	In FY 2009: Experimentally assess responsize-, weight-, and power-restricted preci- applications. Demonstrate constructive s	onsive space "pli sion time, positi ystems engineer	ag-and-play" sa on, and velocit ing model to as	ttellite impleme y sensor techni ssess space-bas	entation concep ques for space- ed assured refe	ot. Design based prence				
(U) (U)	MAJOR THRUST: Develop advanced a	ctive phased arr	ay antenna sub	systems to mee	t the unique rec	quirements of		2.164	3.384	1.954
Proj	ect 44SP			R-1 Line Iten Page-13	n No. 12 of 31				Exhibit R-2a (PE 0602204F)

	Exhibit R-2a, RDT&E Project Justific	cation	DA	TE February	2008
BUD(02 A	GET ACTIVITYPE pplied Research 06	NUMBER AND TITLE 02204F Aerospace Sensors	PROJECT N 44SP Spa	JMBER AND TITLE	
(U)	B. Accomplishments/Planned Program (\$ in Millions) affordable space-based sensing including restrictions on mass, size, and power. Utilize demonstrate low-mass, low-cost, reliable, and scalable apertures. Develop multi-band a technologies. Address technologies for antenna array operations in dynamic sensor netw surveillance, and reconnaissance capabilities.	advanced materials, to nd multi-beam forming vorks. Supports intelligence,	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U)	In FY 2007: Demonstrated low-mass scalable tiles and panels with advanced thermal meticiency for active components. In FY 2008: Develop sub-array-level digital beam-forming and low-cost L-band antenn In FY 2009: Experimentally assess enhanced antenna signal interference compatibility	anagement and improved a panels. capability.			
(U)	MAJOR THRUST: Study adaptive processing techniques for large, multi-mission, space meet the stringent demands of wide-area coverage, target detection, and target tracking is interference environments.	e-based conformal arrays to n severe clutter and	1.693	1.523	1.652
(U)	In FY 2007: Developed adaptive processing techniques suitable for implementation on architectures for multi-intelligence, surveillance, and reconnaissance sensing from space Developed signal processing methods and novel adaptive transmit and receive technique platform.	space-qualified computing e-based platforms. es for a space surveillance			
(U)	In FY 2008: Evaluate adaptive transmit and receive techniques for surface moving targe under a variety of tactical scenarios and interference environments.	et indication from space			
(U)	In FY 2009: Integrate developed algorithms, waveforms, and space platform scenarios sensors.	into a surveillance network of			
(U) (U)	MAJOR THRUST: Develop advanced component technology for space-based sensors to performance and reducing size, mass, and power. Investigate pre-space qualification is component technologies to ensure more rapid and accurate transitions. Supports intellig reconnaissance capabilities.	that focuses on improving use associated with newer gence, surveillance, and	0.909	0.905	1.084
(U) (U)	In FY 2007: Developed and modeled an initial reduced-power architecture for large-are In FY 2008: Validate new low-cost radio-frequency sub-assembly technology compatib Evaluate plastic packaging, liquid crystal polymer packages, and flexible radio-frequence In FY 2000: Develop compact tunchle filters for interference sized rejection in dance of	a antennas. ility for space qualification. y boards.			
(U) (U) (U)	MAJOR THRUST: Develop sensor technologies to achieve highly accurate and robust	navigation performance for	0.000	1.262	1.259
Pro	hypersonic air vehicles in prompt global strike applications. Note: This work is an outg R-1 Line Item Page-14 o	rrowth of other efforts within No. 12		Exhibit R-2a	(PE 0602204F)
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		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	E February	2008	
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER A 0602204F A	ND TITLE erospace Ser	isors	PROJECT NUMBER AND TITLE 44SP Space Sensors			
(U) (U) (U) (U)	B. Accomplishments/Planned Pr this Project. In FY 2007: Not Applicable. In FY 2008: Model hypersonic ai robust navigation techniques for s assess hypersonic navigation techn In FY 2009: Design a radio-freque characteristics, platform trajectori applications. Continue developing	rogram (\$ in Mil ir vehicle plasma space-based applic niques in terms o sency hardware-ir es, and highly acc g a constructive s	llions) characteristics, j cations. Develo f measures of pe n-the-loop testbe curate and robus systems engineer	platform trajecto p a constructive erformance and ed to implement st navigation tec ring model to as	ories, and highly systems enginee warfighter utility hypersonic air v hniques for space sess hypersonic	accurate and ering model to r. ehicle plasma e-based navigation	Ŧ	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	Total Cost	of performance an	id warnighter uti	nty.				8.644	10.176	8.914	
(U) (U) (U) (U) (U)	C. Other Program Funding Sum Related Activities: PE 0602500F, Multi-Disciplinary Space Tech. PE 0603203F, Advanced Aerospace Sensors. PE 0603500F, Multi-Disciplinary Adv Dev Space Tech. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	mary (\$ in Millio <u>FY 2007</u> <u>Actual</u>	ons) <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> <u>Complete</u>	<u>Total Cost</u>	
Pro	ject 44SP			R-1 Line Page	e Item No. 12 e-15 of 31				Exhibit R-2a	(PE 0602204F)	
					185						

Exh	ibit R-2a, F	RDT&E Pro	ject Justifi	cation			DATE	February	2008
BUDGET ACTIVITY 02 Applied Research			PI 0	E NUMBER AND	TITLE ospace Sens	ors	PROJECT NUME 4916 Electro	BER AND TITLE	:h
Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4916 Electromagnetic Tech	21.064	14.217	15.929	14.639	13.889	0.000	0.000	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Note: In FY 2012, efforts in this project will tran result of Base Realignment And Closure law.	sfer to Project	2002, Electron	ic Component	Technology, ar	nd Project 2003	, EO Sensors	& Countermeas	ures Technolog	gy, as a
(U) <u>A. Mission Description and Budget Item</u> . This project develops technologies for sense antennas and associated electronics for airbo ground and air moving target indicators in e radio-frequency sensors. It develops low-co missile threat warning. The project also dev	Justification or systems that orne and space extremely clutte ost active senso velops passive	cover the elect based surveilla red environme ors that use relia multi-dimensio	romagnetic spe ance. It also in nts. The projec able high-perfo nal sensors to i	ectrum from rac vestigates radio ct develops acti rmance solid st improve battlef	lio-frequency to b-frequency sca ive and passive tate component field awareness	o electro-optic attering phenor electro-optica s for target det and identify tl	al. It develops nenology for ap l sensors for us rection and iden meats at long-ra	radio-frequency oplications in e in concert wit tification and ange.	y h
 (U) <u>B. Accomplishments/Planned Program (</u> (U) MAJOR THRUST: Investigate detection of space-based surveillance platforms. (U) In FY 2007: Developed integration technic physics models with signal processing for (U) In FY 2008: Develop techniques for fully-phenomenology, cognitive algorithms, and sensing. (U) In FY 2009: Develop analytical and comp tracking, and classification in a knowledge electromagnetic models of targets and clut 	\$ in Millions) of difficult airb ques for multip improved targe adaptive sensin signal process utationally-effi -aided framewater.	orne and groun le platforms, co t detection. ng and processi ing pertaining cient tools for prk, exploiting	d-based targets ombining elect ing, combining to waveform-di multi-sensor in physics-based	s in clutter from romagnetic targ electromagnet iverse sensing a tegration for ta and data-deper	n airborne or get and clutter ic and distributed rget detection, adent	FY	<u>7 2007</u> 3.516	<u>FY 2008</u> 3.106	<u>FY 2009</u> 3.336
 (U) (U) MAJOR THRUST: Design and develop at (U) In FY 2007: Developed nonlinear embedd beam-forming hardware, enabling the use of microwave-integrated circuits into low-coss radio-frequency structures designed for a r architectures for conformal phased array at (U) In FY 2008: Integrate optimal algorithms demonstrate lower cost lightweight sensor newly-developed digital beam-forming arc 	ntennas for airl ded algorithms of lower cost h st three-dimens niniature seeke ntennas for futt with mixed circ platforms. Des hitectures to no	borne and space that enhance dy ardware. Demo ional micro-ele r radar. Analyzure air-to-air ra- cuit radio-freque monstrate low- ew airborne rad	e-based surveill ynamic range at onstrated the in cetrical/mechan zed and develop dar system app tency wide-ban cost miniature lar platforms.	lance. nd bandwidth o itegration of ical systems-m ped digital bear lications. Id beam-formin seeker hardwar	of digital anufactured m-forming ng hardware to re. Transition		3.724	3.309	3.552
Project 4916			R-1 Line Item Page-16 c 186	n No. 12 of 31				Exhibit R-2a (F	PE 0602204F)

1	Exhibit R-2a, RDT&E Project Just	ification	Dr	February	/ 2008
BUDG 02 A	ET ACTIVITΥ ρ plied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT N 4916 Elec	UMBER AND TITLE	ech
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Develop new low-cost digital beam-forming techniques for miniature of Integrate new detection algorithm with low-cost seeker hardware. Integrate and test beam-forming phased array antennas on airborne radar platforms.	nmanned aerial vehicles. new conformal digital	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)					
(U)	MAJOR THRUST: Design and develop new electro-optical techniques and componidentifying concealed targets.	ents for detecting and	3.238	2.706	2.904
(U)	In FY 2007: Developed Zinc Oxide, Aluminum Nitride, and Gallium Nitride semico high-temperature electro-optical applications. Developed single-crystal Gallium Nitride tection of biological agents in clouds and in harsh battlefield environments. Developed techniques to extend range of agent and target detection. Developed Zinc Oxide, Ga Nitride-based avalanche photodiodes for increased range and detection sensitivity ar communications.	onductors for high-power, ride substrates for use in loped laser detection and ranging illium Nitride, and Aluminum ad for non-line-of-sight covert			
(U)	In FY 2008: Develop new focal plane array materials and avalanche photo-detector autonomous munitions, staring focal plane arrays, and target identification and track two-dimensional pixel-based electronic control circuits for enhanced imaging. Integ	device technologies to enhance ing applications. Develop grate these focal plane arrays with			
(U)	In FY 2009: Develop new quasi-phase-matched materials, such as Gallium Phospha optical sources in mid- and long-wave infrared applications. New materials systems conversion from pump wavelengths between 1 and 2 microns. Continue testing of it	ite, and techniques for efficient will be developed to enable ntegrated focal plane arrays.			
(U)					
(U)	MAJOR THRUST: Develop hardware and software for passive multi-dimensional s spectral wavelength range at high frame rates. Develop metamaterials for conformation increase in funding is due to greater emphasis on metamatarials.	sensing in the thermal infrared l arrays. Note: In FY 2009, this	3.613	3.308	6.137
(U)	In FY 2007: Continued evaluation of the cross dispersion prism-based sensor system evaluation of the cross dispersion prism-based sensor system to field testing various validation and false alarm reduction. Continued the design and development of micr real-time threat warning and battle damage assessment. Evaluated micro-lens multisreal time threat warning and battle damage assessment.	n performance. Expanded assets of interest for target ro-lens multispectral sensor for spectral sensor performance for			
(U)	In FY 2008: Perform critical technical assessments and field tests of hyperspectral e in prior years. Evaluate the potential of sensing rapidly changing electro-optical spe (for example, rocket propelled grenades, mortars, man-portable air defense systems, of collections to define small portable systems that can be fielded to provide rapid ta	electro-optical sensors developed ctra from hot battlefield events and muzzle flash). Use results ctical information to			
Proje	ect 4916 R-1 Line I Page-	tem No. 12 17 of 31		Exhibit R-2a	(PE 0602204F)

Exhibit R-2a, RDT&E Pr	DA	TE February	2008	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NU 4916 Elect	JMBER AND TITLE	ch
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> commanders about the location and type of weapons being fired at frie hyperspectral approach to finding and identifying toxic gas clouds.	endly forces. Perform initial testing on a new	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Develop new electro-optical sensor hardware for detectin high explosive weapons using spectral and hyperspectral intelligence. detection and identification viability and initiate plan for transition. C multispectral sensors and create a small, deployable instrument suitable technology demonstrator. Initiate utility assessment of hyperspectral sensors applications. Develop new hardware to e radiating sensor applications including conformal array antennas and the viability of obtaining metamaterial properties consistent with the c based upon radio frequency integrated circuit applications to enable su	ng chemical, biological, radioactive, nuclear, or Perform initial testing to assess sensor Continue development of hyperspectral and le for moving into transition with an advanced sensors for collecting data at millisecond exploit emerging meta- materials for compact electronics based upon complex media. Assess lemonstration of highly integrated subsystems mall, highly directional antenna element device			
drivers. (U)				
 (U) CONGRESSIONAL ADD: Phased Array Antenna Control Computer (U) In FY 2007: Conducted Congressionally-directed effort for the Phase (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 	r. d Array Antenna Control Computer.	0.996	0.000	0.000
 (U) (U) CONGRESSIONAL ADD: Compact Ultra-sensitive Optical Receive: (U) In FY 2007: Conducted Congressionally-directed effort for a Compace and Loitering Standoff Weapons. 	r for Smart and Loitering Standoff Weapons. ct Ultra-sensitive Optical Receiver for Smart	1.992	0.000	0.000
 (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. (U) 				
 (U) CONGRESSIONAL ADD: Hanscom AFB Collaboration on Meta-M (U) In FY 2007: Conducted Congressionally-directed effort for the Hansc Conformal Antenna Technologies. (U) In FY 2008: Not Applicable. 	aterials and Conformal Antenna Technologies. com AFB Collaboration on Meta-Materials and	0.996	0.000	0.000
(U) In FY 2009: Not Applicable.				
 (U) (U) CONGRESSIONAL ADD: Wideband Digital Airborne Electronic Se (U) In FY 2007: Conducted Congressionally-directed efforts for the Wide 	ensing Array. eband Digital Airborne Electronic Sensing	1.395	0.000	0.000
Project 4916	R-1 Line Item No. 12 Page-18 of 31		Exhibit R-2a	(PE 0602204F)

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008
budg 02 A	ET ACTIVITY pplied Research				PE NUMBER A 0602204F A	ND TITLE erospace Sen	sors	PROJECT NUM	BER AND TITLE	ch
(U)	B. Accomplishments/Planned Pr Array.	ogram (\$ in Mil	<u>lions)</u>				F	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.									
(U) (U)	CONGRESSIONAL ADD: Cente In FY 2007: Conducted Congress: Antennas.	er for Advanced S ionally-directed e	Sensor and Com effort for the Ce	munication Anten Anten for Advance	ennas. ed Sensor and C	ommunication		1.594	0.993	0.000
(U) (U)	In FY 2008: Conduct Congression Antennas. In FY 2009: Not Applicable.	nally-directed eff	ort for the Cente	er for Advanced	Sensor and Con	nmunication				
(U) (U) (U) (U)	CONGRESSIONAL ADD: Optikey Optical Maximum Entropy Verification. 0.000 In FY 2007: Not Applicable. 0.000 In FY 2008: Conduct Congressionally-directed effort for Optikey Optical Maximum Entropy Verification. 0.000								0.795	0.000
(U) (U) (U)	In FY 2009: Not Applicable. Total Cost							21.064	14.217	15.929
(U)	C. Other Program Funding Sumi	mary (\$ in Millio FY 2007 <u>Actual</u>	ons) 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>Estimate</u>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	Total Cost
(U) (U)	Related Activities: PE 0602500F, Multi-Disciplinary Space Technology.									
(U)	PE 0602702F, Command Control and Communications. This project has been									
	coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.									
Proje	ect 4916			R-1 Line Page	Item No. 12 -19 of 31				Exhibit R-2a	(PE 0602204F)

Exhibit R-	-2a, RDT&E Project Justification	DATE February 2008
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NUMBER AND TITLE 4916 Electromagnetic Tech
(U) <u>D. Acquisition Strategy</u> Not Applicable		
Project 4916	R-1 Line Item No. 12 Page-20 of 31	Exhibit R-2a (PE 0602204F

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUD 02 /	GET ACTIVITY Applied Research			F	PE NUMBER AND	o TITLE ospace Sens	ors	PROJECT NUME 6095 Sensor	BER AND TITLE	nology
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
609	5 Sensor Fusion Technology	20.262	19.801	18.348	16.144	17.448	17.609	18.008	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U)	A. Mission Description and Budget Item This project develops the technologies requ automatic target recognition, integrated first that help to precisely locate, identify, and t will enable new covert tactics for successfu	Justification hired to perform e control, and be arget airborne a hl air-to-air and	management a omb damage as nd surface targ air-to-surface s	and fusion of s ssessment. The ets. The proje strikes.	sensor informati is project deterr ect emphasizes f	on for timely an nines the feasib inding reduced	nd comprehens ility of technol signature targe	ive situational logies and conc ets and targets	awareness, cepts for fire co of opportunity.	ntrol It
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and assess s algorithms for rapidly finding, tracking, a In FY 2007: Continued to develop impro- from research and development data colle augment and enhance collected research, a assessment of multi-sensor and sensor fus Completed initial automatic target recognitechnology. Continued automatic target re sensor automatic target recognition techno- recognition performance prediction mode and identification approaches using multip measures for assessing automated exploit	(\$ in Millions) ingle and multi- nd targeting mo ved processing ctions. Continu development, an ion algorithms ition performan ecognition perfo blogies. Labora l. Continued as ple sensor types ation and rapid	-sensor automa bile targets. of, and image f red development of operational of for automated e ce evaluation t formance evaluation tory tested the sessment meth . Continued de response system	tic target recog formation from nt of synthetic data sets. Con exploitation an heory for radar ation theory fo first multi-sen ods and measu evelopment of ns proposed for	gnition and sense n, synthetic aper data generation atinued laborator ad weapon deliv r automatic targ r electro-optical sor automatic ta ures for moving analysis method or post-conflict	for fusion ture radar data tools to ry tests and ery systems. et recognition and multiple arget target tracking ds and force	<u>FY</u>	2 <u>2007</u> 2.427	<u>FY 2008</u> 1.508	<u>FY 2009</u> 2.195
(U)	protection, stability, and security operatio In FY 2008: Continue to develop improve from research and development data colle electro-optical, infrared, and hyper-spectra development of multi-sensor and multi-from research, development, and operational data sensor fusion algorithms for automated ex- recognition performance evaluation theory electro-optical and multiple-sensor automa measures for moving target tracking and i development of analysis methods and measures	ns. ed processing o ctions. Continu al imagery data equency synthet tta sets. Contin eploitation and v y for radar autor atic target recog dentification ap asures for assess	f, and image for the to develop in from research the data generat ue laboratory to weapon deliver matic target rec gnition technolo proaches using sing automated	prmation from, nage and data and developm- ion tools to au ests and assess y systems. En cognition techr ogies. Continu g multiple sens exploitation a	synthetic apertu formation and p ent data collecti agment and enha sment of multi-s hance automati- nology and cont ue assessment m or types. Conti and rapid respon	ure radar data processing of ons. Continue unce collected ensor and c target inue for nethods and nue se systems				
Pro	ject 6095			R-1 Line Iter Page-21 104	m No. 12 of 31 1				Exhibit R-2a (PE 0602204F)

	Exhibit R-2a, RDT&E Project Jus	DA	February	2008	
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NU 6095 Sens	IMBER AND TITLE or Fusion Tech	nnology
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) proposed for post-conflict force protection, stability, and security operations. In FY 2009: Assess the processing of, and image formation from, synthetic apertur and hyper-spectral imagery data from research and development data collections tal phenomenology to improve automatic target recognition detection, classification, and Develop and validate multi-sensor and multi-frequency synthetic data generation to enhance collected research, development, and operational data sets. Initiate develop supporting other phenomenological features that heretofore have not been exploited assessment of multi-sensor and sensor fusion algorithms for automated exploitation Enhance automatic target recognition performance evaluation theory for radar autom technology and continue for electro-optical and multiple-sensor automatic target rec- assessment methods and measures for moving target tracking and identification app types. Continue development of analysis methods and measures for assessing autom response systems proposed for post-conflict force protection, stability, and security	e radar, electro-optical, infrared, king advantage of disparate nd identification performance. ols required to augment and pment of tools and technology . Continue laboratory tests and and weapon delivery systems. matic target recognition cognition technologies. Continue roaches using multiple sensor nated exploitation and rapid operations.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop, evaluate, and demonstrate target signature models to recognition and sensor fusion algorithm development and testing for reconnaissance In FY 2007: Continued to mature target signature models for signature exploitation electro-optical multi-spectral systems, and signals intelligence sensors. Continued to and modeling support for multiple radio-frequency and electro-optical phenomenols of tactical ground targets. Continued to generate synthetic air and ground target sign support automatic recognition of targets in operationally realistic mission environme synthetic-scene data generation capability for radio-frequency scenes and continue scene capability applicable to large-area reconnaissance coverage. Continued invest signal processing and exploitation techniques. Continued development of automati algorithm-driven radio-frequency sensor design, new modes of operation for existing and exploitation for high-diversity data. In FY 2008: Develop and validate target signature models for signature exploitation electro-optical multi-spectral systems, and signals intelligence sensors. Develop sign modeling support for multiple radio-frequency and electro-optical phenomenology tactical ground targets, including civilian vehicles. Continue to generate synthetic awith sufficient fidelity to support automatic recognition of targets in operationally realisity for radio-frequency and electro-optical phenomenology tactical ground targets, including civilian vehicles. Continue to generate synthetic awith sufficient fidelity to support automatic recognition of targets in operationally realisity for radio-frequency and electro-optical phenomenology. Reference and signals intelligence sensors. Develop signates and electro-optical phenomenology tactical ground targets, including civilian vehicles. Continue to generate synthetic awith sufficient fidelity to support automatic recognition of targets in operationally relations.	support automatic target e and strike mission applications. of radio-frequency sensors, to develop signatures, algorithms, ogy automatic target recognition natures with sufficient fidelity to ents. Demonstrated a development of an electro-optical tigation of model-driven spectral c target recognition g sensors, and signal processing n of radio-frequency sensors, gnatures, algorithms, and automatic target recognition of tir and ground target signatures ealistic mission environments. equency scenes and continue	3.416	3.897	5.477
Pro	ect 6095 Page	22 of 31		Exhibit R-2a	(PE 0602204F)
	1	92			

	Exhibit R-2a, RDT&E Project Justifica	DA	February	2008	
BUD(02 A	GET ACTIVITYPE N pplied Research 0602	UMBER AND TITLE 2204F Aerospace Sensors	PROJECT N 6095 Sens	UMBER AND TITLE	hnology
(U)	B. Accomplishments/Planned Program (\$ in Millions) development of an electro-optical scene capability applicable to large-area reconnaissance investigation of model-driven spectral signal processing and exploitation techniques. Mea automatic target recognition algorithm-driven radio-frequency sensor design, new modes sensors, and signal processing and exploitation for high-diversity data.	coverage. Continue asure performance of initial of operation for existing	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue to mature target signature models for signature exploitation of radi electro-optical multi-spectral systems, and signals intelligence sensors. Continue to devel and modeling support for multiple radio-frequency and electro-optical phenomenology au of tactical ground targets. Initiate the development of signatures, algorithms, target model modeling of other phenomenological features that heretofore have not been exploited. Con air and ground target signatures with sufficient fidelity to support automatic recognition or realistic mission environments. Continue demonstration of a synthetic-scene data generat radio-frequency scenes and continue development of an electro-optical scene capability appreconnaissance coverage. Continue investigation of model-driven spectral signal processi techniques. Continue development of automatic target recognition algorithm-driven radio new modes of operation for existing sensors, and signal processing and exploitation for hi	o-frequency sensors, op signatures, algorithms, tomatic target recognition ling, and phenomenological ntinue to generate synthetic f targets in operationally ion capability for oplicable to large area ng and exploitation -frequency sensor design, gh-diversity data.			
(U) (U)	MAJOR THRUST: Develop and demonstrate enabling automatic target recognition, sens fusion technologies for target detection, tracking, and identification in intelligence, surveil combat identification applications	or management, and sensor lance, reconnaissance, and	13.323	10.405	8.102
(U) (U)	In FY 2007: Continued fusion of exploitable radar, electro-optical, infrared, laser detection hyper-spectral features for target detection, tracking, and identification with sensor manage Continued evaluation of physics-based techniques for target detection and identification for surveillance, reconnaissance, and combat identification applications. Continued develops will capitalize on precision time, position, attitude, and velocity sensor data to enable imprecapabilities for future distributed-time and distributed-platform sensing. Investigated pixet techniques. Continued development of capabilities to represent and utilize sensor parametro other uncertainty reference information, for improved fused geo-location accuracy. Contribio-inspired automatic target recognition for robustness. Continued automatic target recognition for urban intelligence, surveillance, and reconnais unmanned aerial vehicles. In FY 2008: Develop and validate a fusion capability of exploitable radar, electro-optical, and ranging, and hyperspectral features for target detection, tracking, and identification with sensor fusion research for target detection, tracking, and identification with the sensor fusion research for target detection intelligence is a fusion capability of exploitable radar, electro-optical, and ranging, and hyperspectral features for target detection, tracking, and identification with the sensor fusion research for target detection.	on and ranging, and ement techniques. or intelligence, ment of technology that roved geo-location d-level registration ters and errors, along with mued research of gnition, sensor ssance from small , infrared, laser detection ith sensor management			
Proj	ect 6095 R-1 Line Item No Page-23 of 3	5. 12 1		Exhibit R-2a	(PE 0602204F)
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	Exhibit R-2a, RDT&E Project Justifi	DA	^{⊤∈} February	2008	
BUD(02 A	BET ACTIVITY PE	E NUMBER AND TITLE 602204F Aerospace Sensors	PROJECT NI 6095 Sens	JMBER AND TITLE or Fusion Tech	nnology
(U)	B. Accomplishments/Planned Program (\$ in Millions) techniques. Evaluate physics-based techniques for target detection and identification fo and reconnaissance and combat identification applications. Initiate development of auto analysis. Continue development and initiate assessment of technology that will capitalin position, attitude, and velocity sensor data to enable improved geo-location capabilities and distributed platform sensing. Continue development of multi-sensor pixel level reg Continue development of capabilities to represent and utilize sensor parameters and error uncertainty reference information, for improved fused geo-location accuracy. Continue automatic target recognition for robustness. Extend automatic target recognition, senso fusion research for urban intelligence, surveillance, and reconnaissance from small unrr include civilian objects of interest.	or intelligence, surveillance, comated battle space behavior ze on precision time, for future distributed time istration techniques. ors, along with other research of bio-inspired r management, and sensor panned aerial vehicles to	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Complete initial fusion capability for radar, electro-optical, infrared, laser hyper-spectral features for target detection, tracking, and identification with sensor man Evaluate and improve of physics-based techniques for target detection and identification surveillance, and reconnaissance and combat identification applications. Continue development of automated battle space behavior analysis. Continue development of techn precision time, position, attitude, and velocity sensor data to enable improved geo-locat distributed time and distributed platform sensing, and initiate its inclusion into fusion fue evaluate multi-sensor, pixel-level registration techniques. Continue development of cap utilize sensor parameters and errors, along with other uncertainty reference information geo-location accuracy. Continue research of bio-inspired automatic target recognition f evaluation of these techniques for urban applications. Evaluate automatic target recogn and sensor fusion research for urban intelligence, surveillance, and reconnaissance from vehicles.	detection and ranging, and agement techniques. In for intelligence, elopment and initiate toology that will capitalize on ion capabilities for future functions. Complete and babilities to represent and for improved fused for robustness and initiate ition, sensor management, a small unmanned aerial			
(U) (U) (U) (U)	MAJOR THRUST: Develop fundamental technical methods required for algorithm per target recognition driven sensing, layered sensing and other sensing and exploitation tec automatic target recognition capabilities. Note: This work is an outgrowth of other wor In FY 2007: Not Applicable. In FY 2008: Assess the state-of-the-art in automatic target recognition predictive method	formance models, automatic chnologies impacted by k within this project. ods. Determine exploitation	0.000	2.402	2.574
(U)	and sensing technologies that require the integration of automatic target recognition tech fundamental automatic target recognition approaches for various subcomponents. In FY 2009: Evaluate new innovations in automatic target recognition-related technolo	hniques. Develop gies. Continue development			
Pro	ect 6095 R-1 Line Item Page-24 c 194	No. 12 f 31		Exhibit R-2a	(PE 0602204F)

	Exhibit R-2a, RDT&E Project Ju	stification	DA	TE February	/ 2008
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT NI 6095 Sens	JMBER AND TITLE or Fusion Tecl	hnology
(U)	B. Accomplishments/Planned Program (\$ in Millions) of fundamental automatic target recognition approaches for subcomponents. Beg unified automatic target recognition methodology, building upon the various auto subcomponent efforts.	in development of an integrated, matic target recognition	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)					
(U)	(U) MAJOR THRUST: Develop, evaluate, and demonstrate distributed trusted	multi-layered sensing architectures			
	for persistent sensing and decision support within air, space, and cyber application	on domains			
(U)	(U) In FY 2007: Not Applicable.				
(U)	(U) In FY 2008: Develop new technologies and methodologies for defining add trusted collaborative heterogeneous sensor systems and semantic sensor networks system of systems sensor engineering and analysis. Initiate development of new situation awareness and predictive analytics to optimize object driven, self-organic for multi-layered sensing.	aptive architectures for distributed b. Develop new techniques for techniques for sensor network zing collaborative sensor systems			
(U)	(U) In FY 2009: Continue to development of new technologies and methodologies architectures for distributed trusted collaborative heterogeneous sensor systems and Continue to develop new techniques for system of systems sensor engineering and new techniques for sensor network situation awareness and predictive analytics to self-organizing collaborative sensor systems for multi-layered sensing. Initiate reto identify critical areas and technologies needed for next generation semantic series and technologies needed for next generation semanti	gies for defining adaptive nd semantic sensor networks. d analysis. Continue to develop o optimize object driven, esearch into sensor network science nsor networks.			
(U)					
(U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced Sensor Aided Vigilance Technologies. In FY 2007: Conducted Congressionally-directed effort for Advanced Sensor Aid In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ded Vigilance Technologies.	1.096	0.000	0.000
(0)	CONGRESSIONAL ADD: Sensor Eusion		0.000	1 589	0.000
(0)	In FY 2007: Not Applicable		0.000	1.507	0.000
(U) (U)	In FY 2009: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Sensor Fusion. In FY 2009: Not Applicable.				
(U)	Total Cost		20.262	19.801	18.348
	R-1 Lit	ne Item No. 12			
Pro	ect 6095 Pa	ge-25 of 31		Exhibit R-2a	(PE 0602204F)
		GEI			

		Exhibit R-	2a, RDT&E	Project Ju	stification			DATE	February 2008	
BUE 02	DGET ACTIVITY Applied Research				PE NUMBER A 0602204F A	ND TITLE	isors	PROJECT NUMBER AND TITLE 6095 Sensor Fusion Technology		
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	ons)							
		<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> Total Cost	
		<u>Actual</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>	<u>Complete</u>	
(U)	Related Activities:									
(U)	PE 0602500F, Malki Dissiniinama Susaa									
	Multi-Disciplinary Space									
an	PE 0603203E Advanced									
(0)	Aerospace Sensors									
ധ	PE 0602602F. Conventional									
(-)	Munitions.									
(U)	PE 0603270F, Electronic									
	Combat Technology.									
(U)	PE 0603226E, Experimental									
	Evaluation of Major Innovative									
	Technologies.									
(U)	PE 0603762E, Sensor and									
	Guidance Technology.									
(0)	I his project has been									
	Reliance 21 process to									
	harmonize efforts and eliminate									
	duplication.									
an	D Acquisition Stratogy									
(0)	Not Applicable									
	Tot ripplicable.									
1										
1				R-1 Line	e Item No. 12					
Pr	oject 6095			Pag	e-26 of 31				Exhibit R-2a (PE 0602204F)	
					196					

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008	
BUDG 02 A	BET ACTIVITY pplied Research			F	PE NUMBER AND 1602204F Aer	o TITLE ospace Sens	ors	PROJECT NUM 7622 RF Sen Tech	ROJECT NUMBER AND TITLE 622 RF Sensors & Countermeasures ech		
	Cost ([§] in Millions)	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	Complete		
7622	RF Sensors & Countermeasures Tech	33.470	25.623	22.829	23.547	25.997	24.564	25.300	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
	A. Mission Description and Budget Item This project develops and assesses affordal including intelligence, surveillance, reconn surveillance, reconnaissance, fire control ra surface and airborne targets with radio-free severe clutter, or heavy jamming. Techniq advanced waveforms, and knowledge aided advanced electronic combat applications. S and hostile command and control networks defensive radio-frequency sensors, includin	ble, reliable, all- naissance, and fi adar, electronic quency signatur ues exploited ir d processing tec Specifically, it os s. The project a ng radar warnin	weather radio- re control, both combat, and in es that are diffi- aclude the use of hniques. This levelops techn lso exploits em g, radio-freque	-frequency sent h active and particular definition icult to detect of of multiple rad project also define iques and technole ency electronic	sing concepts for assive. This pro- and electronic of lue to reduced r io-frequency phe evelops the radio nologies to deter logies and comp combat, and electronic	or aerospace ap ject also develo combat systems adar cross-sect enomenologies o-frequency wa ct and counter to ponents to prov ectronic intellig	plications cove ops and evalua ons, concealm , multi-dimen- rning and cour the links and so ide increased c ence application	ering the range tes technology es the detecting nent and camou sional adaptive ntermeasure tec ensors of threat capability for of ons.	of radar sensors for intelligence and tracking of flage measures, processing, chnology for t air defense sys ffensive and	s , f , stems	
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop advanced w operations to improve interference rejected frequency, delay, polarization, modulation size, weight, and power reductions in radii platforms. Develop technology to enable drops in FY 2008 and FY 2009 due to red	(\$ in Millions) aveforms for ac on, self-protecti n, and coding. 1 o-frequency ser affordable upgr luced multiple-i	hieving transn on, and target Develop techno isors compatib rades to radio-f ntelligence adv	nit adaptivity a identification b ologies and tec le with severel frequency signa vanced radar se	nd simultaneous by exploiting div hniques to prov y constrained us al receivers. No ensor technolog	s multi-mode versity in ide significant nmanned aerial ote: Funding y development	<u>F</u> Y]	<u>7 2007</u> 17.770	<u>FY 2008</u> 16.480	<u>FY 2009</u> 6.375	
(U) (U)	In FY 2007: Developed and evaluated ad radar applications that support multiple de processing concepts that seamlessly integr operation in complex signal environments radio-frequency sensors compatible with s techniques to provide concurrent radio-fre single platform. Determined system-level modeling, simulation, and analysis. In FY 2008: Develop and evaluate advan radio-frequency radar and electronic warf	vanced digital r egree-of-freedor rate with receiv s. Continued de severely constra equency radar a l multi-intellige ced mode-contr are compatibilit	eceiver and ex m adaptivity. I er technologies evelopment to r ined unmanne nd electronic w nce trades thro rol concepts to ry on a single p	citer technolog Developed and s to support inc reduce size, we d aerial platfo varfare with ele ugh integrated provide concur- platform. Deve	ties for electron evaluated adva creased levels of ight, and power rms. Refined in ectro-optical con radar and electro rrent multi-func- elop integrated r	ic security and nced signal f adaptivity for in novative mpatibility on a ronic warfare tion adio-frequency					
Proje	ect 7622			R-1 Line Iter Page-27	m No. 12 of 31 7				Exhibit R-2a (PE 0602204F)	

	Exhibit R-2a, RDT&E Project Just	DA	TE February	/ 2008		
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT N 7622 RF S Tech	ECT NUMBER AND TITLE RF Sensors & Countermeasures		
(U)	B. Accomplishments/Planned Program (\$ in Millions) (radar and electronic warfare) and electro-optical modeling, simulation, and analysis system-level multi-intelligence trades. Develop advanced digital receiver techniques for passive multi-mode platform operations. Continue development and evaluation of exciter technologies for electronic security and radar applications that support multip adaptivity. Continue development and evaluation of advanced digital receiver signal techniques for adaptive operation in complex signal environments. Perform digital receiver signal analysis for electronic security scenarios in modern signal environments. Refine power in radio-frequency sensors compatible with severely constrained unmanned age	capabilities to address broader for adaptive electronic security f advanced digital receiver and le degrees-of-freedom processing concepts and eceiver simulation, modeling reductions in size, weight, and rial platforms.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Continue to develop and evaluate advanced mode-control concepts to p radio-frequency radar and electronic warfare with electro-optical compatibility on a s approaches allowing the simultaneous design and development of sensors and their b Develop advanced electronic security digital receiver concepts and techniques for spa overcome limitations to precision emitter parameterization in complex environments evaluation of advanced adaptive digital receiver and exciter technologies for electron multi-mode applications. Continue digital receiver simulation, modeling, and analys scenarios in modern signal environments. Continue to refine reductions in size, weig radio-frequency sensors compatible with severely constrained unmanned aerial platfor	rovide concurrent single platform. Define ack-end exploitation functions. atial and temporal adaptivity to . Continue development and ic security, radar and, passive is for electronic security tht, and power in prms.				
(U) (U)	MAJOR THRUST: Develop robust, ultra-wide-bandwidth antenna technology for us aerospace platform electronic apertures. Develop innovative technologies and archite apertures to provide more functionality on a set of platforms. Assess next-generation aperture technology. Note: Funding drops in FY 2008 due to completion of wide-ba	se in operational and future octures for extremely wide-band applied radio-frequency and aperture development.	4.260	0.831	1.735	
(U) (U) (U)	In FY 2007: Fabricated and tested thin-profile wide-band receiver array. Extended a function. Evaluated performance of directional wideband array transmitter. Comple compact wideband direction-finding antenna for close-in sensing. In FY 2008: Integrate compact digital receiver and exciter to thin-profile array. In FY 2009: Laboratory demonstration and testing of thin-profile array with integrat	ed receiver and exciter.				
(U) (U) (U)	MAJOR THRUST: Develop multi-function radio-frequency-sensing concepts and ra element-level arrays for concurrent multi-mode operation. In FY 2007: Designed autonomous constellation of active and passive air, space, and	dio-frequency transformational	2.756	1.277	3.747	
Pro	R-1 Line It ect 7622 Page-2 19	em No. 12 8 of 31 08		Exhibit R-2a	(PE 0602204F)	

	Exhibit R-2a, RDT&E Project Just	DA	February	2008	
BUDGET / 02 Appl i	ACTIVITY ied Research	PE NUMBER AND TITLE 0602204F Aerospace Sensors	PROJECT N 7622 RF S Tech	UMBER AND TITLE	termeasures
(U) <u>B.</u> clo con sub	Accomplishments/Planned Program (\$ in Millions) ose-in sensing applications using distant sources of opportunity. Performed system ncurrent operation to determine multi-mode array performance. Initiated technolo bsystems for element-level multi-mode digital beam forming.	ns-engineering analysis of gy development of critical	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In clo mu	FY 2008: Develop autonomous constellation of active and passive air, space, and ose-in sensing applications using distant sources of opportunity. Design and devel alti-mode array to demonstrate concurrent operation.	ground sensor techniques for op panel technology for			
(U) In for ele	FY 2009: Demonstrate autonomous constellation of active and passive air, space, r close-in sensing applications using distant sources of opportunity. Demonstrate a ment-level digital beam forming.	and ground sensor techniques and test multi-mode array with			
(U)					
(U) MA for	AJOR THRUST: Develop digital radio-frequency receiver and exciter technology rming.	to support digital beam	3.583	2.341	2.991
(U) In adv adv red cor	FY 2007: Demonstrated receiver and exciter technologies that support digital beavanced electronic support and radar sensor systems. Performed laboratory integra duced size, weight, and power receiver and exciter technologies that support multi ncepts.	um-forming functionality for tion and demonstration of -function radio-frequency sensor			
(U) In rad	FY 2008: Develop subsystem engineering, simulation, and characterization techn dio-frequency aperture, wideband receiver/exciter, and digital beam-forming signa	ologies for integrated wideband l processing.			
(U) In dig dig cha	FY 2009: Demonstrate advanced wideband radio-frequency aperture and widebar gital beam-forming signal processing subsystem to validate subsystem engineering aracterization technologies.	nd receiver and exciter with g, simulation, and			
(U) (U) MA ope fre pro gro	AJOR THRUST: Develop advanced waveforms for achieving transmit adaptivity eration to improve interference rejection, self-protection, and target identification equency, delay, polarization, modulation, and coding. Develop multi-platform, mu pocessing algorithms that improve detection and location performance for advanced pound-based targets in severe clutter and jamming environments.	and simultaneous multi-mode by exploiting diversity in ilti-mission radar-adaptive I cruise missiles, air-, and	4.105	4.694	7.981
(U) In sig sig tec	FY 2007: Developed optimal waveforms for multi-sensor and multi-mode radar. gnal processing algorithms that are suitable for multi-sensor and multi-mode opera gnal processing techniques for moving target indicator surveillance platforms. Eva chnology for next-generation deep-reach target detection and tracking.	Developed advanced radar tion. Evaluated wideband radar aluated distributed processing			
Project 7	7622 R-1 Line I Page-2	tem No. 12 29 of 31		Exhibit R-2a	(PE 0602204F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DAT	February	2008
BUD 02 A	GET ACTIVITY Applied Research				PE NUMBER A 0602204F A	ND TITLE erospace Sen	sors	PROJECT NUI 7622 RF Se Tech	CT NUMBER AND TITLE RF Sensors & Countermeasures	
(U) (U) (U)	B. Accomplishments/Planned Pro In FY 2008: Evaluate distributed p tracking. Utilize high-fidelity simu In FY 2009: Initiate and conduct e adaptive transmit waveforms, new multi-band, multi-platform, and sh	ogram (\$ in Mil processing techn alation tools. Pla experiments to de distributed sense ared aperture ap	llions) ology for next-g an for future exp emonstrate the a or receive proces plications.	eneration deep- periments. dvantages and p ssing techniques	reach target dete erformance imp s, and distributed	ection and rovements of l sensing for	I	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U)	CONGRESSIONAL ADD: Senso In FY 2007: Conducted Congressi In FY 2008: Not Applicable. In FY 2009: Not Applicable	r Network Techi onally-directed o	nology. effort for Sensor	Network Techr	nology.			0.996	0.000	0.000
(U)	Total Cost							33.470	25.623	22.829
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602500F, Multi-Disciplinary Space Technology. PE 0603203F, Advanced Aerospace Sensors. PE 0603253F, Advanced Avionics Integration. PE 0602782A, Command, Control, Communications Technology. PE 0602232N, Navy C3 Technology. PE 0603792N, Advanced Technology Transition. This project has been coordinated through the	<u>nary (\$ in Milli</u> <u>FY 2007</u> <u>Actual</u>	<u>ons)</u> <u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	<u>FY 2013</u> Estimate	Cost to Complete	<u>Total Cost</u>
Pro	ject 7622			R-1 Line Page	e-30 of 31				Exhibit R-2a	(PE 0602204F)
				2	200					

Exhibit R-2a, RDT&E	Exhibit R-2a, RDT&E Project Justification					
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>						
Reliance 21 process to harmonize efforts and eliminate duplication.						
(U) <u>D. Acquisition Strategy</u> Not Applicable.						

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PE NUMBER: 0602601F PE TITLE: Space Technology

	Exhibit R-2, RDT&E Budget Item Justification								February	2008
BUDGE 02 Ap	JDGET ACTIVITY PE NUMBER AND TITLE 2 Applied Research 0602601F Space Technology									
	Cost (\$ in Millions)	FY 2007 Actual	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	101.316	128.397	117.519	104.647	114.942	114.797	113.866	Continuing	TBD
1010	Space Survivability & Surveillance	48.497	48.773	47.528	45.905	46.313	44.269	44.345	Continuing	TBD
4846	Spacecraft Payload Technologies	15.027	26.380	21.470	19.471	19.592	22.075	22.005	Continuing	TBD
5018	Spacecraft Protection Technology	1.798	2.532	6.257	6.927	7.994	6.194	5.178	Continuing	TBD
8809	Spacecraft Vehicle Technologies	35.994	50.712	42.264	32.344	41.043	42.259	42.338	Continuing	TBD
8809 Spacecraft Vehicle Technologies 35.994 50.712 42.264 32.344 41.043 42.259 42.338 Continuing TBD Note: Funds for the FY 2008 Congressionally-directed Center for Solar Electricity and Hydrogen in the amount of \$2.4 million were moved from PE 0602203F, Aerospace Propulsion, Project 6233SP, to this PE 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.										
se C	ttings. The last major area, spacecraft ve ongress added \$2.0M for Advanced Mod	ehicles, focuses Jular Avionics fo	on spacecraft p or Operationall [,]	latform, payloa v Responsive S	id, and control pace Use, \$2.0	technologies, a M for Multicor	nd their interac ntinuum Techno	tions. Note: I	n FY 2008, e Structures, \$().5M

for Mission Design and Analysis Tool, \$0.35M for Shielding Rocket Payloads, \$1.6M for Deployable Structure Systems for Space, \$1.6M for Field Programmable Gate Arrays, \$3.2M for High-frequency Active Auroral Research Program (HAARP), \$1.6M for Microsatellite Target System, \$2.4M for Nuclear Test Seismic Research, and \$2.0M for Reconfigurable Electronics and Non-Volatile Memory Research. 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.

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

		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget	103.472	109.566	106.755
(U)	Current PBR/President's Budget	101.316	128.397	117.519
(U)	Total Adjustments	-2.156	18.831	
(U)	Congressional Program Reductions		-0.013	
	Congressional Rescissions		-0.806	
	Congressional Increases		17.250	
	Reprogrammings	-0.672	2.400	
	SBIR/STTR Transfer	-1.484		
(U)	Significant Program Changes:			
	Changes to this PE since the Previous President's Budget are due to higher Air Force priorities.			
	R-1 Line Item No. 13			
	Page-1 of 19		Exhibit F	R-2 (PE 0602601F)

Exhibit R-2	DATE February 2008	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	· · ·
C. Performance Metrics (U) Under Development.		
	R-1 Line Item No. 13 Page-2 of 19 204	Exhibit R-2 (PE 0602601F)

	ExI	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008	
BUDGI 02 A ¢	UDGET ACTIVITY 2 Applied Research				PE NUMBER AND TITLE PROJECT 0602601F Space Technology 1010 S Surve			PROJECT NUME 1010 Space S Surveillance	OJECT NUMBER AND TITLE 10 Space Survivability & Irveillance		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total	
1010	Space Survivability & Surveillance	48.497	48.773	47.528	45.905	46.313	44.269	44.345	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
T I I I I I I	This project develops the technologies to e battlespace environment for realistic space ncludes technologies to specify and foreca space-based surveillance operations, and all project includes the seismic research progr	exploit the space system design, ast the environm llow the opportu- ram that support	environment f modeling, and ent from "mud unity to mitigate s national requi	or warfighter's simulation, as to sun" for pla e or exploit the irements for mo	future capabilit well as the batt unning operation space environmonitoring nuclea	ties. The project lespace enviror hs and ensuring nent for both o ar explosions.	ct focuses on c ment's effect of uninterrupted ffensive and do	haracterizing an on space system system perforn efensive operati	nd forecasting t as' performance nance, optimize tons. Finally, th	he 2. It 9. his	
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop technologie environmental conditions hazardous to De performance, reduce cost, and increase op In FY 2007: Developed energetic electro to dynamic radiation belt model to provid model to global geospace environment me model of solar explosive events, including beam and wave probes of radiation belt de	(\$ in Millions) s for specifying epartment of De perational lifetin n data assimilati data-driven sp odels to increase g flares, bursts, a ynamics.	monitoring, p fense (DoD) op nes. on models for ecification and e accuracy and and coronal ma	redicting, and c perational spac real-time situat forecast capat lead time. Con ass ejections. E	controlling space e systems in ord tional awarenes bility. Coupled mpleted initial p Developed conce	e der to improve s by coupling radiation belt oredictive epts for active	FY	<u>2007</u> 5.071	<u>FY 2008</u> 6.810	<u>FY 2009</u> 8.892	
(U)	In FY 2008: Complete detailed analysis of operational heliospheric imager. Initiate in Initiate development of magnetic reconner program to test and evaluate empirical fla observatory assets. Complete developme awareness by coupling to dynamic radiati Continue coupling of radiation belt model time. Validate models for ionospheric per injection into the magnetosphere.	of Solar Mass E measurement of ection model to s are prediction mo nt of energetic e on belt model to l to global geosp netration by ver	ection Imager. interplanetary tudy solar flare odels based on lectron data as provide data- oace environme y low frequenc	Compile spec magnetic field e initiation and synoptic data f similation mod driven specifica ent models to ir y (VLF) electro	cifications and g s using wide-fie energy storage from Air Force lels for real-tim ation and foreca ncrease accuracy omagnetic wave	guidance for eld radio array. . Initiate and national e situational ast capability. y and lead es and their					
(U)	In FY 2009: Continue measurement of in 1 magnetic reconnection model to study s evaluate empirical flare prediction models Complete coupling of radiation belt mode	nterplanetary ma colar flare initiat s based on synop el to global geos	gnetic fields us ion and energy ptic data from A pace environm	sing wide-field storage. Conti Air Force and r ent models to i	radio array. Co inue program to national observa ncrease accurac	omplete Spiral o test and atory assets. cy and lead					
Proje	ct 1010			R-1 Line Iten Page-3 c	n No. 13 of 19				Exhibit R-2a (I	PE 0602601F)	
				205	5						

	Exhibit R-2a, RDT&E Project Jus	[⊤] E February	/ 2008		
BUD(02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NU 1010 Space Surveillan	JMBER AND TITLE • Survivability ce	- 7 &
(U)	B. Accomplishments/Planned Program (\$ in Millions) time. Utilize three-dimensional global radiation belt diffusion models to simulate u wave-particle interactions from VLF electromagnetic wave power injected in narro Validate models for virtual VLF electromagnetic wave generation in the ionospher- distribution.	ultimate global effect of w altitude slices of radiation belts. e and global transport and power	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop spectral signature libraries, target detection technique application to space-based surveillance, laser weapons, and countermeasure system low-observable targets, and targets and space-based resident space object character	es, and decision aids for us, including detection of ization.	16.131	13.531	14.496
(U)	In FY 2007: Demonstrated technologies for space-based detection, identification, a space object characterization, environmental monitoring, and missile warning/defert techniques for space-based resident space objects for space situational awareness. The spectral processing and exploitation algorithms and related signature databases to a thermal spectral sensors, validated nighttime spectral processing algorithms and related signature concepts the commands as appropriate. Refined real-time hypertemporal processing algorithms optimal parameters for operational system. Developed third generation (model) hy Transitioned improved stratospheric clear air turbulence forecast models to Air For technology requirements for transition of operational decision aids for airborne lase systems, and laser communication systems.	and characterization for resident nse. Developed super-resolution Fransitioned initial validated ppropriate users. With available ated signature databases for to acquisition and operational ; and determined additional pertemporal sensor for space. ce Weather Agency. Addressed ers, tactical high-energy laser			
(U)	In FY 2008: Finalize real-time hypertemporal (HT) processing algorithms with optimissile launch detection. Continue development of third-generation brassboard HT launch detection. Begin feasibility study of HT applications for technical intelliger space-based platforms. Use satellite tracking test bed and Air Force Maui Optical at telescopes to demonstrate Space Situational Awareness (SSA) capability of HT sent technique to obtain operational and health status of resident space objects. Other are polarimetric and temporal capabilities are considered in the down selection phase a needed. Complete analysis of space data on real world detections of resident space thermal infrared, visible, and ultraviolet and develop models of sensor performance space-based sensors. Utilize planned space demonstrations to validate spectral thermissions and supporting models. Continue transition of spectral image processing related signature databases to government users. Begin investigation of spectral approximations of the spectral approximation of spectral approximation of spectral approximation of spectral approximation of spectral approximations and support of the spectral thermatic spectral the spectral transition of spectral image processing related signature databases to government users. Begin investigation of spectral approximations approximation of spectral approximation of spectral approximations approximation of spectral approximations approximation of spectral approximations approximation of spectral approximations approximations approximation of spectral approximations approximations approximation of spectral approximations approximations approximations approximation approximation approximation approximations approximations approximations approximation approximation approximation approximation approximation approximatio	timal parameters for space-based S sensor for space-based missile and Supercomputing tracking isors and validate the utility of this dvanced sensors of spectral, nd tested with ground systems as objects with multiple band to evaluate capability of ater surveillance and area search and exploitation algorithms and oplications for material			
Pro	ject 1010 R-1 Line Pag	Item No. 13 e-4 of 19		Exhibit R-2a	(PE 0602601F)
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	Exhibit R-2a, RDT&E Project Jus	DA	DATE February 2008			
BUD 02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT N 1010 Space Surveillar	T NUMBER AND TITLE pace Survivability & llance		
(U)	B. Accomplishments/Planned Program (\$ in Millions) identification in support of military chemical/biological weapons detection and ider and other bands	ntification in the thermal infrared	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Finalize brassboard HT sensor for space-based missile launch detection HT processing algorithms into sensor platform. Transition brassboard sensor and a space-based missile launch detection. Test feasibility of HT applications for techni and space-based platforms. Define the requirements and the optimum configuration Develop end-to-end simulation capability, based on the sensor performance models and space operator community in trade space analyses of sensors or sensor suites. T capabilities to derive information and intelligence about space objects with signals regimes. Continue investigation of spectral applications for material identification chemical/biological weapons detection and identification algorithms and related sign users. Complete analysis and documentation of military utility of planned space de surveillance and area search missions. Complete validation of hyperspectral model	on. Incorporate latest real-time lgorithms to customer for cal intelligence from ground, air, n of a space-based HT sensor. , to assist acquisition community The emphasis is on the in all bands and all temporal in support of military d other bands. Complete ature databases to government monstrations of spectral theater s.				
(U) (U)	MAJOR THRUST: Develop artificial intelligence techniques, forecasting tools, an ionospheric specification and forecasting, including communications/navigation ou space-based geolocation demonstrations, and determination and prediction of radar	d sensors for improved tage forecasting (C/NOFS),	6.181	7.020	7.515	
(U)	In FY 2007: Performed metric tests of C/NOFS scintillation forecasting system. In ionospheric specification and forecasting algorithms and models for enhanced milit system. Investigated coupled solar-magnetospheric-ionospheric-thermospheric motimes for radar operations, and communications/navigation outages. Developed por measuring total electron content and communications/navigation scintillation.	ntegrated C/NOFS results into ary utility of scintillation warning dels to improve forecast lead rtable ionospheric sensor suite for				
(U)	In FY 2008: Expand high-latitude data collection to initiate a high-latitude scintilla the impact of convection of scintillations to higher latitudes on Ultra High Frequence Positioning System (GPS) navigation systems. Investigate HF induced artificial sci High-frequency Active Auroral Research Program (HAARP). Develop portable ion measuring total electron content and communications/navigation scintillation. Initi ionosphere compensation study. Develop scintillation mitigation technology by usi Develop techniques of analyzing GPS radio occultation data acquired by C/NOFS a System for Meteorology, Ionosphere and Climate (COSMIC) satellites. Begin inco	tion warning system. Investigate cy communication and Global intillation generation using the nospheric sensor suite for ate space radar data collection for ing metal-oxide space cloud. and Constellation Observing orporation of Kalman filter				
Pro	ject 1010 R-1 Line Page	Item No. 13 -5 of 19		Exhibit R-2a	(PE 0602601F)	
	2	207				

	Exhibit R-2a, RDT&E Proje	DA	February	/ 2008	
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NUMBER AND TITLE 1010 Space Survivability & Surveillance		
(U)	B. Accomplishments/Planned Program (\$ in Millions) ionospheric model into forecast models and ionospheric warfighter impact p neutral density to improve accuracy of empirical neutral density models for during geomagnetic storms. Implement algorithm to assess impacts of pene equatorial irregularities.	products. Conduct statistical analysis of specifying and forecasting neutral density etration electric fields on generation of	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Investigate solar activity on enhancement of L-band scintillati scintillation database and tools to military communication and navigation sy and scintillations over the African subcontinent for better defining the equa environment in the middle-eastern region. Demonstrate scintillation mitiga cloud. Deliver ionospheric compensation technique with wide-band radio- techniques for specifying high temporal resolution of neutral density and sa situation awareness. Improve empirical and neutral density model based or experiment data and develop physics-based model of the neutral composition of physics-based 3-D model of equatorial plasma bubbles into warfighter pri- Kalman filter operational models into equatorial models.	ions to assess the support of the ystems. Measure total electron content torial scintillation and GPS error ation technology using metal-oxide space frequency waves. Improve modeling atellite drag to achieve predictive space in Atmospheric Density Specification on, wind, and density. Continue transition roducts and transition of ionospheric			
(U) (U)	MAJOR THRUST: Develop High-frequency Active Auroral Research Pro	gram site transmitting and diagnostic	9.596	9.070	9.841
(U)	instrument infrastructure. In FY 2007: Validated performance of 3.6 megawatt transmitting array in 1 Frequency (ELF/VLF) wave generation and optical emissions research proc	Extremely Low Frequency/Very Low			
(U)	In FY 2008: Conduct experimental research with the 3.6 megawatt transmi increase the efficiency of ELF/VLF wave generated in space and initiate res with charged particles in the earth's radiation belts	itting array to develop techniques to search to characterize their interactions			
(U)	In FY 2009: Continue research to characterize wave-particle interactions at and their potential application to mitigate charged particle effects on space	nd wave amplification effects in space systems and operations.			
(U) (U)	MAJOR THRUST: Develop basic seismic technologies to support national explosions with special focus on regional distances less than 2,000 kilomete	l requirements for monitoring nuclear ers from the sensors.	7.099	6.777	6.784
(U)	In FY 2007: Updated seismic codes for operational use. Developed hypoth discrimination and yield estimation techniques, while addressing unresolver partition, magnitudes, and source physics. Incorporated seismic energy par and regional seismic wave propagation. Developed efforts on seismic calib	hesis test results into potential d hypothesis issues for seismic energy tition effects into implications for local pration; seismic detection, location, and			
Proj	ect 1010	R-1 Line Item No. 13 Page-6 of 19		Exhibit R-2a	(PE 0602601F)

	^{⊤∈} February	2008			
BUDO 02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT NU 1010 Spac Surveillan	JMBER AND TITLE Se Survivability Ce	&
(U)	B. Accomplishments/Planned Program (\$ in Millions) discrimination; and observational studies of seismic wave propagation, inclu- future directions based on results obtained so far.	uding propagation in Eurasia. Assessed	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Test and incorporate new research methods for automated proceedent events. Develop long-period regional seismic discrimination, while examine discrimination. Continue efforts on seismic calibration; seismic detection, l observational studies of seismic wave propagation, including propagation in studies to transition the program to meet emerging local seismic monitoring theoretical, laboratory, and field studies to support local monitoring.	cessing of increasing numbers of seismic ing challenges in high-frequency regional ocation, and discrimination; and n Eurasia. Conduct comprehensive requirements. Design and conduct			
(U)	In FY 2009: Flyoff different techniques for automated processing of increa detailed research on causes of challenges in high-frequency regional discrim seismic calibration; seismic detection, location, and discrimination; and obs propagation, including propagation in Eurasia. Continue to conduct detailed local seismic monitoring. Refine design and conduct theoretical, laboratory monitoring.	sing numbers of seismic events. Conduct nination. Further continue efforts on ervational studies of seismic wave d studies of particular challenge areas in o, and field studies to support local			
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: USAF Center for National Security Research - In FY 2007: Conducted Congressionally-directed effort for USAF National In FY 2008: Not Applicable. In FY 2009: Not Applicable.	Signature. I Security Research - Signature.	1.277	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: High-frequency Active Auroral Research Prog In FY 2007: Conducted Congressionally-directed effort for HAARP. In FY 2008: Conduct Congressionally-directed effort for HAARP. In FY 2009: Not Applicable.	ram.	3.142	3.180	0.000
(U) (U) (U) (U)	CONGRESSIONAL ADD: Nuclear Test Seismic Research In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Nuclear Test Seis In FY 2009: Not Applicable	mic Research.	0.000	2.385	0.000
(U) (U)	Total Cost		48.497	48.773	47.528
Proj	ect 1010	R-1 Line Item No. 13 Page-7 of 19		Exhibit R-2a	(PE 0602601F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008	
BUD 02 /	BUDGET ACTIVITY 02 Applied Research			PE NUMBER AND TITLE 0602601F Space Technology			PROJECT NUMBER AND TITLE 1010 Space Survivability & Surveillance			
(U)	C. Other Program Funding Sum	nary (\$ in Milli	ons)							
		<u>FY 2007</u> Actual	<u>FY 2008</u> 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	Complete Total Cost	
(U) (U) (U) (U) (U) (U) (U) (U)	Related Activities: PE 0305111F, Weather Systems. PE 0305160F, Defense Meteorological Satellite Program. PE 0601102F, Defense Research Sciences. PE 0602204F, Aerospace Sensors. PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.									
Pro	ject 1010			R-1 Line Pag	e Item No. 13 e-8 of 19				Exhibit R-2a (PE 0602601F)	
				UNCL	210 ASSIFIED					
	Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
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BUDG 02 A p	ET ACTIVITY oplied Research			P 0	YE NUMBER AND 1602601F Spa	TITLE ce Technolo	gy	PROJECT NUME 4846 Spacec Technologies	BER AND TITLE raft Payload s	
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4846	Spacecraft Payload Technologies	15.027	26.380	21.470	19.471	19.592	22.075	22.005	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Note: Comn	Funds for the FY 2007, Congressionally- nand, Control and Communications, Proje	directed Space- ct 6266SP, for e	Qualified Compared Com	mon Data Link	in the amount	of \$2.2 million	were moved f	from this Projec	t to PE 060270	2F,
f c t t	Finis project develops advanced technolog our primary areas: (1) development of ad- lata generation and exploitation technolog echnologies; (3) development of high-fide he warfighter; and (4) development of ad- communication systems.	vanced, space-qu gies, including in elity space simul vanced networki	spacectart pay. ialified, surviva frared, Fourier ation models th ng, radio frequ	able electronics Transform hyp nat support spa ency, and laser	s, and electronic perspectral ima ice-based survei r communicatio	component and cs packaging te ging, polarimet illance and space ns technologies	schnologies; (2 ric sensing, an ce asset protec s to support ne	development ad satellite anter tion research an xt generation sa	of advanced sp ina subsystem id development itellite	for
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop advanced in space detector arrays with improved dete such as decoys, satellites, and warheads t In FY 2007: Pursued detector response t	(\$ in Millions) frared device te ction, to perform hroughout their unability. Comp	chnologies for a acquisition, tr trajectory. sleted assessme	space applicati acking, and dis nt of quantum	ions that enable scrimination of interference to	hardened space objects wards	<u>F</u> Y	<u>7 2007</u> 2.773	<u>FY 2008</u> 4.139	<u>FY 2009</u> 5.458
(U)	amplification of incoming weak signals. arrays (FPAs). Pursued long-wave infrar In FY 2008: Continue investigating spec Demonstrate a three-layer single pixel po optimization.	Studied radiatio ed (LWIR) supe tral agility. Beg larimeter. Cont	n damage of ve rlattice defect n in investigating inue LWIR sup	ery long waveled reduction and p g field-enhance perlattice defect	ength and visib passivation opti ement technolog t reduction and	le focal plane mization. gies. passivation				
(U)	In FY 2009: Continue investigating spec increments. Continue investigating field interference and demonstrate enhanceme Demonstrate improved LWIR superlattic	tral agility. Der enhancement ter nt using plasmor e detector and as	nonstrate tunin chnologies. De ns. Continue in ssess very long	g from 15 to 20 emonstrate amp westigating the wave infrared	0 microns in 1 r plification using e single pixel po feasibility.	nicron g quantum blarimeter.				
(U) (U)	MAJOR THRUST: Develop spectral ser sensing applications.	nsing and data ex	ploitation met	nodologies for	military imagin	ng and remote		0.762	1.130	1.328
(U)	In FY 2007: Completed validation of po data to measured field data. Completed i	larimetric scene nitial polarimetr	and signature r ic database of 1	nodeling capat naterials for us	bility, comparin se in signature a	g simulated and scene				
Proje	ct 4846			R-1 Line Iten Page-9 c	n No. 13 of 19				Exhibit R-2a (PE 0602601F)

	Exhibit R-2a, RDT&E Project Jus	tification	DA	TE February	/ 2008
BUD(02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT N 4846 Space Technolog	UMBER AND TITLE cecraft Payload gies	
(U)	B. Accomplishments/Planned Program (\$ in Millions) modeling. Defined concepts for polarimetric or multi-band imaging sensors for spa applications.	ce-based space surveillance	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Begin development of a predictive model for advanced imaging conce models, develop an end-to-end capability to predict the performance, benefit, and co Intelligence, Surveillance, and Reconnaissance (ISR) and SSA applications.	epts. Using the physics-based ost of various sensors for			
(U)	In FY 2009: Complete the development and begin the validation of a predictive model. Validate against laboratory and available field data of ISR and SSA missions. Mak capability to improve accuracy and usability of the model. Utilize the prediction capurpose built sensors for SSA.	odel for advanced imaging. e improvements to the simulation pability to develop concepts for			
(U) (U)	MAJOR THRUST: Develop technologies for space-based payload components suc performance, radiation-hardened electronic devices, micro-electro-mechanical syste electronics packaging for next generation high performance space electronics	ch as low power, high em devices, and advanced	2.424	3.682	4.410
(U)	In FY 2007: Completed study of dynamics of phase change materials, and of their is technological dmaterials. Explored use of polymers in reconfigurable electronics. A advanced electronics, especially the nitrided oxides. Collaborated with the Air Ford Directorate on nanotechnology. Researched radiation effects mitigation schemes us design and manufacturing to identify new methods for creating radiation hardened, custom mixed signal microcircuits for next generation space and missile systems. I hardening techniques to determine robustness and compatibility with state of the ar-	interactions with pertinent Studied alternative dielectrics for ce Research Laboratory Materials sing best commercial practices in long-lifetime, commodity and Evaluated devices using advanced t design and fabrication			
(U)	In FY 2008: Initiate capabilities to the current Satellite Design Automation softwar form a "push-button toolflow" satellite builder. Initiate radiation-harden space sens standardized data messages protocols from sensors for ease device control of sensor	The evolve a logical sequence to or interface modules allocating rs and actuators.			
(U)	In FY 2009: Complete capabilities to the current Satellite Design Automation softw to form a "push-button toolflow" satellite builder. Demonstrate radiation-harden sp allocating standardized data messages protocols from sensors for ease device contro	vare to evolve a logical sequence pace sensor interface modules of sensors and actuators.			
(U) (U)	MAJOR THRUST: Develop modeling, simulation, and analysis tools for space-bas rendezvous and proximity operations, optical/infrared imaging space systems, distri space control payloads. Note: In FY 2008, increase in funding is due to acceleration	sed surveillance systems, buted satellite architecture, and on of the development of	2.190	6.387	3.027
Proj	ect 4846 R-1 Line Page	Item No. 13 -10 of 19		Exhibit R-2a	(PE 0602601F)

	Exhibit R-2a, RDT&E Projec	DA	DATE February 2008			
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT N 4846 Spac Technolog	JMBER AND TITLE cecraft Payload		
(U)	B. Accomplishments/Planned Program (\$ in Millions) engineering and military utility models for space superiority analysis of spac counterspace technologies	e situational awareness and defensive	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Supported autonomous and responsive space flight experiments Extended the simulation architecture to feed engineering-level data to missio simulation architecture to support flight experiment simulation and data valid situational awareness and tactical surveillance.	s with simulations and data validation. on/campaign models. Readied the dation for experiments on space				
(U)	In FY 2008: Complete support of autonomous and responsive space flight ex- validation. Complete extension of the simulation architecture to feed engine models. Begin to develop engineering and military utility models for space s awareness and defensive counterspace technologies.	xperiments with simulations and data ering-level data to mission/campaign superiority analysis of space situational				
(U)	In FY 2009: Continue to develop engineering and military utility models for situational awareness and defensive counterspace technologies.	r space superiority analysis of space				
(U) (U)	MAJOR THRUST: Develop technologies for multi-access laser communical single access terminal components and their applicability to a multi-access terminal components and their applicability to a multi-access terminal provide the second standards of multiple airborne intelliger and space asset feeds into a single optical data path. Performed system testing	tions terminals. Assess the maturity of erminal design. nce, surveillance and reconnaissance ng using laboratory testbed.	4.816	7.464	7.247	
(U) (U)	In FY 2008: Begin integration of single-access laser communications termin communications terminal. In FY 2009: Complete integration of single-access laser communications ter laser communications terminal.	rminal components into multi-access laser				
(U) (U) (U)	CONGRESSIONAL ADD: Nanoscale Microelectronic Circuit Technology In FY 2007: Conducted Congressionally-directed effort for Nanoscale Micro Development.	Development. oelectronic Circuit Technology	1.080	0.000	0.000	
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.					
(U) (U) (U)	CONGRESSIONAL ADD: Field Programmable Gate Arrays. In FY 2007: Conducted Congressionally-directed effort for Field Programm In FY 2008: Conduct Congressionally-directed effort for Field Programmab	able Gate Arrays. le Gate Arrays.	0.982	1.590	0.000	
Pro	ect 4846	R-1 Line Item No. 13 Page-11 of 19 213		Exhibit R-2a	(PE 0602601F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER AND TITLE PROJECT 0602601F Space Technology 4846 S Technology 100 100 100 100 100 100 100 100 100 10				ECT NUMBER AND TITLE Spacecraft Payload nnologies		
(U) (U)	B. Accomplishments/Planned P In FY 2009: Not Applicable.	rogram (\$ in Mil	<u>lions)</u>				<u>F</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U)	CONGRESSIONAL ADD: Reco In FY 2007: Not Applicable. In FY 2008: Conduct Congressio Research.	nfigurable Electron	onic and Non-V ort for Reconfig	olatile Memory gurable Electroni	Research.	atile Memory		0.000	1.988	0.000	
(U) (U)	In FY 2009: Not Applicable. Total Cost							15.027	26.380	21.470	
(U) (U) (U) (U)	C. Other Program Funding Sum Related Activities: PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>mary (\$ in Millio</u> <u>FY 2007</u> <u>Actual</u>	ons) <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>	
Pro	bject 4846			R-1 Line Page	e Item No. 13 -12 of 19				<u>Exhibit R-2a (</u>	(PE 0602601F)	
	0ject 4846 Page-12 of 19 Exhibit R-2a (PE 0602601F) 214 UNCLASSIFIED										

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008	
BUD(02 A	GET ACTIVITY pplied Research			F O	PE NUMBER AND 0602601F Spa	TITLE ce Technolo	gy	PROJECT NUME 5018 Spacec Technology	BER AND TITLE	n	
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
5018	3 Spacecraft Protection Technology	1.798	2.532	6.257	6.927	7.994	6.194	5.178	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
(U)	<u>A. Mission Description and Budget Item</u> This project develops the technologies for performance loss in support of warfighter r technologies, and developing technologies	A. Mission Description and Budget item Justification This project develops the technologies for protecting U.S. space assets in potential hostile environments to assure continued space system operation without performance loss in support of warfighter requirements. The project focuses on identifying and assessing spacecraft system vulnerabilities, developing threat warning technologies, and developing technologies to mitigate the effects of both intentional and unintentional threats. B. Assemulishments/Development (frim Milliong)									
(U)	B. Accomplishments/Planned Program	(\$ in Millions)					FY	2007	FY 2008	FY 2009	
(U) (U) (U) (U) (U)	B. Accomplishments/Planned Program (\$ in Millions)FY 2007FY 2007FY 2008FY 2009MAJOR THRUST: Develop key satellite threat warning technologies and tools for high value satellite asset defense.0.7911.0202.810Note: In FY 2009, increase in funding is due to increased emphasis on defensive counterspace technologies.0.7911.0202.810Note: In FY 2007: Conducted sensor testing and analysis. Identified technology transition opportunities.0.7911.0202.810In FY 2008: Continue to conduct sensor space flight experiment and analysis. Identify technology transition opportunities and provide associated engineering designs and concepts.In FY 2009: Transfer an active and/or passive threat warning sensor for detection of a direct assent or co-orbital vehicle and transition these engineering designs.Here 2009Here 2009										
(U) (U) (U)	MAJOR THRUST: Develop high value s is due to increased emphasis on defensive In FY 2007: Conducted defensive techno opportunities. In FY 2008: Develop space experiment u	pace asset defer counterspace te logy space dem sing onboard sy	nsive capabiliti echnologies. onstration and stems or devel	es. Note: In analysis. Iden	FY 2009, increa tified technolog ncept space exp	eriment to		0.513	0.864	1.657	
(U) (U)	validate concept and multiple use technologi In FY 2009: Identify two technology opti geosynchronous orbit/low earth orbit sate	ogy. ons that provide llites and compl	e defensive cap ete engineering	ability for inco g designs.	orporation into						
(U)	MAJOR THRUST: Develop techniques t satellite-as-a-sensor, and self-aware satell increase in funding is due to increased em	o exploit existir ite technologies phasis on defen	ng on-board inl as a first-line sive countersp	herent satellite threat detection ace technologi	resources, n system. Note: es.	In FY 2009,		0.494	0.648	1.790	
(U) (U)	In FY 2007: Conducted defensive techno opportunities. In FY 2008: Transition technology to oth	er compatible s	onstration and	analysis. Iden or multiple use	tified technolog	y transfer					
Proj	ect 5018			R-1 Line Iter Page-13 215	m No. 13 of 19 5				Exhibit R-2a (I	PE 0602601F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUDGET A 02 Applie	ACTIVITY ed Research				PE NUMBER AND TITLE PROJE 0602601F Space Technology 5018 Techn				CT NUMBER AND TITLE Spacecraft Protection nology		
(U) <u>B. 4</u> (U) In F (U) Tot	Accomplishments/Planned Pr FY 2009: Identify technology t al Cost	ogram (\$ in Mil transition opportu	lions) inities and provi	de engineering o	designs to potent	tial users.	E	<u>Y 2007</u> 1.798	<u>FY 2008</u> 2.532	<u>FY 2009</u> 6.257	
(U) <u>C. C</u> (U) PE C	Other Program Funding Sum 0603401F, Advanced	mary (\$ in Milli o <u>FY 2007</u> <u>Actual</u>	ons) FY 2008 Estimate	<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> Estimate	<u>Cost to</u> Complete	<u>Total Cost</u>	
Spac (U) This coor Relia harn dupl	cecraft Technology. a project has been redinated through the ance 21 process to nonize efforts and eliminate lication.										
(U) <u>D. A</u> Not .	Applicable.										
Project 50	018			R-1 Line Page	e Item No. 13 e-14 of 19				Exhibit R-2a	(PE 0602601F)	
					216 ASSIFIED						

	Ex	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
budg 02 A j	ET ACTIVITY oplied Research			P 0	PE NUMBER AND 0602601F Spa	CE Technolog	gу	PROJECT NUME 8809 Spaceci Technologies	BER AND TITLE raft Vehicle	
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
8809	Spacecraft Vehicle Technologies	35.994	50.712	42.264	32.344	41.043	42.259	42.338	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Note: Aeros (U)	Funds for the FY 2008 Congressionally- pace Propulsion, Project 6233SP, to this I A. Mission Description and Budget Item	directed funds fo Project, for exect n Justification	or the Center fo ation.	r Solar Electrio	city and Hydrog	gen in the amou	int of \$2.4 mil	lion were moved	d from PE 0602	2203F,
(2 1	This project focuses on seven major space (e.g., survivable electronics); satellite con- simulation of space-based systems; satelli- nicrosatellite technologies; and space exp	e technology area trol (e.g., softwa te protection tecl periments of mate	as: spacecraft p re for autonom nnologies (e.g., uring technolog	latforms (e.g., ous distributed space environ gies for space q	structures, conta l satellite format ment effects, de qualification.	rols, power, and tion flying, sigr ebris prediction	d thermal man nal processing, , and threat wa	agement); space , and control); m arning/attack rep	e-based payload nodeling and porting);	ds
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop technologic high efficiency solar power cells and arra In FY 2007: Developed component-base cryocooler system design. Designed an u advanced engineering model cryocooler. Demonstrated greater than 33% efficient technology. Developed a greater than 12 centimeters in area.	n (\$ in Millions) es for advanced s ays, and innovati ed system model ultra low-temper Transitioned op solar cell using 2% efficient thin-	space platform ve power gener of pulse tube c ature (10 degre otimal design m either lattice m film solar cell	subsystems sub ration concepts ryocoolers for es Kelvin), low nethodologies t ismatch or five on a polymer s	ch as cryocoole s. parametric opti w mass and high to cryocooler ind e- or six- junctic substrate at least	rs, compact, mization of a efficiency dustry. on solar cell t 20 square	<u>F</u> Y	<u>7 2007</u> 3.109	FY 2008 4.406	<u>FY 2009</u> 4.266
(U)	In FY 2008: Continue to refine and valid Complete theoretical model of multistage mechanisms in regenerative cycle cryoco and begin procurement technology devel infrared/medium-wavelength infrared (S ⁴ technical intelligence missions. Develop	date cryocooler c e cooler energy f polers through co lopment design w WIR/MWIR) cry o advanced conce	component and lows. Continu- omputational flu- vork for improv- vocooler applic ept solar cells tr	system models e to investigate uid dynamics n yed short-wave ation needs for raceable to effi	s with experime e thermodynami nodels. Comple elength r missile launch ciencies greater	ntal data. c loss ete definition detection and t than 40%.				
(U)	In FY 2009: Further refine and validate to investigate thermodynamic loss mecha dynamics models. Complete design wor detection and technical intelligence missi thin-film solar cells scaleable to greater t	cryocooler comp anisms in regene k for improved S ion systems. Co than 100 kw.	oonent and syste rative cycle cry SWIR/MWIR c mplete enginee	em models wit vocoolers throu ryocooler appl pring demonstra	h experimental ligh computation lication for miss ation of advance	data. Continue nal fluid ile launch ed array for	2			
(0)										
Proie	act 8809			R-1 Line Iter Page-15	m No. 13 of 19				Exhibit R-2a (I	PF 0602601F)
				217	7					

	Exhibit R-2a, RDT&E Project Just	ification	D.	February	/ 2008
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT N 8809 Spa Technolo	IUMBER AND TITLE cecraft Vehicle gies	
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) MAJOR THRUST: Develop technologies for advanced space platform structures su vibration suppression, multi-functional structures, deployable large aperture optical composite satellite and launch vehicle structures. Note: In FY 2008 and out, increase emphasis on spacecraft structures.	ich as structural controls for arrays, and lightweight se in funding is due to increased	<u>FY 2007</u> 6.078	<u>FY 2008</u> 10.567	<u>FY 2009</u> 14.639
(U)	In FY 2007: Characterized thermal protection structural performance in reentry env concepts to support defensive/protection actions by spacecraft	ironment. Developed autonomy			
(U)	In FY 2008: Complete characterization of thermal protection structural performance support defensive/protection actions by spacecraft. Begin development of multifunc concepts for space situational awareness, such as structural health monitoring, light and detection of RF emissions. Initiate development of system-level architectures for structures. Commence development of advanced estimation algorithms for better lo existing and next-generation hardware, such as star-trackers for object detection, characterization and star-trackers for object detection and star-trackers for ob	e. Provide autonomy concepts to ctional structural hardware occultation by nearby objects, or large precision deployable cal situational awareness using aracterization, and tracking.			
(U)	In FY 2009: Continue development of multifunctional structural hardware concepts such as structural health monitoring, light occultation by nearby objects, and detectind evelopment of system-level architectures for large precision deployable structures. advanced estimation algorithms for better local situational awareness using existing such as star-trackers for object detection, characterization, and tracking.	for space situational awareness, on of RF emissions. Continue Continue development of and next-generation hardware,			
(U)					
(U) (U)	MAJOR THRUST: Develop flight experiments to address key scientific and technolimprove the capabilities of existing operational space systems and to enable new transition. Funding changes are due to launch preparation activities and higher Air Force. In FY 2007: Completed Critical Design Review for all payloads to freeze all design flight hardware. Completed fabrication of integrated encourses of a second technology.	logical problems in order to nsformational space capabilities. e priorities. s and authorize fabrication of all two and electronics. Delivered	15.333	25.355	23.359
(U)	individual experiment payloads and prepared to assemble, integrate, and test with th In FY 2008: Complete delivery of all spacecraft payloads. Complete spacecraft ass Train mission operations team for on-orbit activities. Prepare science teams for on-or data to certify the dissemination and analysis process.	e core spacecraft. embly, integration and test. orbit operations using simulated			
(U)	In FY 2009: Prepare spacecraft for launch. Complete all spacecraft to launch vehic approval. Launch spacecraft and commence with Mission Operations.	le interface analysis and			
(U)					
(U)	CONGRESSIONAL ADD: Integrated Control for Autonomous Space Systems (IC	ASS).	1.571	0.000	0.000
Proj	ect 8809 R-1 Line Page-	tem No. 13 16 of 19		Exhibit R-2a	(PE 0602601F)
	2	18			

	Exhibit R-2a, RDT&E Project Just	ification	DA	DATE February 2008		
BUDG 02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602601F Space Technology	PROJECT N 8809 Space Technolog	JMBER AND TITLE ecraft Vehicle gies		
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Conducted Congressionally-directed effort for ICASS.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Elastic Memory Composites (EMC).		0.982	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Elastic Memory Compos	sites.				
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U) (U)			1 000	0.000	0.000	
(\mathbf{U})	CONGRESSIONAL ADD: Deployable Structures Experiment.		1.080	0.000	0.000	
(\mathbf{U})	In FY 2007: Conducted Congressionally-directed effort for Deployable Structures E	xperiment.				
(\mathbf{U})	In FY 2008: Not Applicable					
(\mathbf{U})	In FY 2008: Not Applicable.					
(0)	CONCRESSIONAL ADD: Florible CIGS Solar Colls on Silicone Substrates for Sp	acacraft	0.082	0.000	0.000	
(0)	In EV 2007: Conducted Congressionally directed affort for Elavible CIGS Solar Cal	ls on Silicona Substratas for	0.982	0.000	0.000	
(0)	Spacecraft	is on Sincole Substrates for				
an	In EV 2008: Not Applicable					
	In FY 2008: Not Applicable					
(U)	CONGRESSIONAL ADD: Joint Micro Power Initiative		0.982	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Joint Micro Power Initia	tive.	0.702	0.000	0.000	
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Three Dimensional Deployable Structure Systems for Sp	pace.	1.080	0.000	0.000	
Ú	In FY 2007: Conducted Congressionally-directed effort for Three Dimensional Depl	lovable Structure Systems for				
Ì	Space.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
Proi	R-1 Line It	em No. 13 7 of 19		Exhibit P 20	(PE 0602601E)	
110	20 Color Payeri	19			(i = 0002001F)	

	Exhibit R-2a, RDT&E Project Justifi	cation	DA	TE February	2008
BUD(02 A	GET ACTIVITY PE pplied Research 00	E NUMBER AND TITLE 602601F Space Technology	PROJECT N 8809 Space Technolog	JMBER AND TITLE cecraft Vehicle gies	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	CONGRESSIONAL ADD: Lightweight Photovoltaic Electricity and Hydrogen for Por	rtable, On-Demand	3.535	2.384	0.000
	Power/Center for Solar Electricity and Hydrogen.				
(U)	In FY 2007: Conducted Congressionally-directed effort for Center for Solar Electricity	and Hydrogen.			
(U)	In FY 2008: Conduct Congressionally-directed effort for Center for Solar Electricity and	nd Hydrogen.			
(U)	In FY 2009: Not Applicable.				
(U) (U)			0.000	1 000	0.000
(U)	CONGRESSIONAL ADD: Multicontinuum Technology for Space Structures.		0.982	1.988	0.000
(U) (U)	In FY 2007: Conducted Congressionally-directed effort for Multicontinuum Technology	gy for Space Structures.			
(U)	In FY 2008: Conduct Congressionary-directed errort for Municontinuum Technology	for space structures.			
(0)	III I I 2009. Not Applicable.				
(0)	CONGRESSIONAL ADD: Shield Rocket Payloads / Shielding Rocket Payloads		0.280	0 347	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Shield Rocket Payloads		0.200	0.517	0.000
(U)	In FY 2008: Conduct Congressionally-directed effort for Shielding Rocket Payloads.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Modular Avionics for Operationally Responsive	e Space Use.	0.000	1.988	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct Congressionally-directed effort for Advanced Modular Avionics	for Operationally Responsive			
	Space Use.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Deployable Structure Systems for Space.		0.000	1.590	0.000
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct Congressionally-directed effort for Deployable Structure System	s for Space.			
(U)	In FY 2009: Not Applicable.				
(U)			0.000	1 500	0.000
(U) (U)	CONGRESSIONAL ADD: Microsatellite Target System.		0.000	1.590	0.000
(\mathbf{U})	In FY 2007: Not Applicable.				
(U)	In FY 2008: Conduct Congressionary-directed errort for Microsatenne Target System.				
(0)	III 1 2007. Not Applicable.				
	R-1 Line Item	No. 13			
Pro	ect 8809 Page-18 c	of 19		Exhibit R-2a	(PE 0602601F)
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BUDGET ACTIVITY O2 Applied Research PE AUMBER AND TITLE PE ACCOMPLISHMENT ACTIVITY O2 Applied Research PE ACCOMPLISHMENT ACTIVITY O602601F Space Technology PE 2007 EY 2008 EY 2009 EY 2009 EY 2009 EY 2000 U CONCRESSIONAL ADD: Mission Design and Analysis Tool. U In FY 2008: Conduct Congressionally-directed effort for Mission Design and Analysis Tool. U In FY 2008: Conduct Congressionally-directed effort for Mission Design and Analysis Tool. U In FY 2009: Not Applicable. EY 2009 EY 2010 EY 2010 EY 2011 EY 2012 EY 2013 EY 2013 EY 2014 EY 2014 EY 2014 EY 2012 EY 2013 EY 2014 EY 2014 EY 2014 EY 2015 EY 2015 EY 2015 EY 2016 EY 2016 EY 2011 EY 2012 EY 2013 Cost to EY 2013 EY 2014 EY 2014 EY 2014 EY 2014 EY 2015 EY 2013 EY 2014 EY 2014 EY 2014 EY 2015 EY 2013 EY 2014 EY 2015 EY 2014 EY 20			DATE	February	2008						
Ub B. Accomplishments/Planned Program (\$ in Millions) FY 2007 FY 2008 FY 2009 (U) CONGRESSIONAL ADD: Mission Design and Analysis Tool. 0.000 0.497 0.000 (U) In FY 2007: Not Applicable. 0.000 0.497 0.000 (U) In FY 2009: Not Applicable. 35.994 50.712 42.264 (U) In FY 2009: Not Applicable. 35.994 50.712 42.264 (U) Total Cost 35.994 50.712 42.264 (U) FY 2007 FY 2008 FY 2009 FY 2011 FY 2012 FY 2013 Cost to Total Cost (U) Related Activities: Complete FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Total Cost (U) Related Activities: Complete Estimate Estimate Estimate Estimate Complete Total Cost (U) Pedictod Activities: Complete Total Cost Complete Total Cost (U) Related Activities: Cost of Total Cost Cost of Total Cost Complete Total Cost (U) Pedictod Activities: Cost of Total Cost Cost of Total Cost Cost of Total Cost Complete Rost of Total Cost (U)	BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER A 0602601F S	ND TITLE pace Technol	PROJECT NUM 8809 Spaced Technologie	ROJECT NUMBER AND TITLE 809 Spacecraft Vehicle rechnologies		
 CONGRESSIONAL ADD: Mission Design and Analysis Tool. CONGRESSIONAL ADD: Mission Design and Analysis Tool. In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Mission Design and Analysis Tool. In FY 2009: Not Applicable. Total Cost 25.994 50.712 42.264 C. Other Program Funding Summary (\$ in Millions) EY 2007: EY 2010 EY 2007 EY 2007 EY 2007 EY 2007 EY 2008 EY 2009 EY 2010 EY 2011 EY 2012 EY 2013 Cost to Cost to Cost to Actual Estimate Estimate Estimate Estimate Estimate Complete Total Cost PE 6062102F, Materials. <l< th=""><th>(U)</th><th>B. Accomplishments/Planned Pr</th><th><u>ogram (\$ in Mil</u></th><th><u>lions)</u></th><th></th><th></th><th></th><th>H</th><th><u>TY 2007</u></th><th><u>FY 2008</u></th><th><u>FY 2009</u></th></l<>	(U)	B. Accomplishments/Planned Pr	<u>ogram (\$ in Mil</u>	<u>lions)</u>				H	<u>TY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) C. Other Program Funding Summary (5 in Millions) FY 2007 FY 2008 FY 2009 FY 2011 FY 2012 FY 2013 Cost to Total Cost Actual Estimate Estim	 (U) (U) (U) (U) (U) (U) (U) 	CONGRESSIONAL ADD: Missi In FY 2007: Not Applicable. In FY 2008: Conduct Congression In FY 2009: Not Applicable. Total Cost	on Design and A nally-directed effe	nalysis Tool. ort for Mission	Design and Ana	lysis Tool.			0.000 35.994	0.497 50.712	0.000
FY 2007 FY 2008 FY 2009 FY 2011 FY 2012 FY 2013 Cost to Complete 10 Pelated Activities: Complete Total Cost (10) PE 0602203F, Aerospace Propulsion. For each of the stimate Estimate	(U)	C. Other Program Funding Sumi	mary (\$ in Millio	ons)							
(U) <u>D. Acquisition Strategy</u> Not Applicable. Project 8809 R-1 Line Item No. 13 Project 8809 Exhibit R-2a (PE 0602601F) 221	(U) (U) (U) (U) (U) (U)	Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602102F, Materials. PE 0603311F, Ballistic Missile Technology. PE 0603401F, Advanced Spacecraft Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	FY 2007 Actual	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>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
221	(U) Pro	D. Acquisition Strategy Not Applicable.			R-1 Line Page	e Item No. 13				Exhibit R-2a	PE 0602601F)
	Pro	IECI 9808			Page	221				Exhibit R-2a (PE 0602601F)

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PE NUMBER: 0602602F PE TITLE: Conventional Munitions

	Exhik	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDG 02 A	ET ACTIVITY oplied Research			PI 0	E NUMBER AND	TITLE	initions			
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	60.150	58.632	55.963	60.781	58.725	56.638	59.159	Continuing	TBD
2068	Advanced Guidance Technology	18.493	17.778	17.982	19.171	19.206	18.354	19.299	Continuing	TBD
2502	Ordnance Technology	41.657	40.854	37.981	41.610	39.519	38.284	39.860	Continuing	TBD
(U)	A. Mission Description and Budget Item	Justification								
	air-launched munitions. The program includes two projects: (1) development of advanced guidance technologies, including seekers, navigation and control, target 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. Note: In FY 2008, Congress added \$1.2 million for Advanced Nanotube Micro-Munition Weapon Technology Initiative. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies.									
(U)	B. Program Change Summary (\$ in Mil	llions)								
							<u>FY 2007</u>	<u>FY 2</u>	2008	<u>FY 2009</u>
(U)	Previous President's Budget						61.868	57	.804	56.081
(U)	Current PBR/President's Budget						60.150	58	.632	55.963
(U)	Total Adjustments						-1.718	0	0.828	
(U)	Congressional Program Reductions									
	Congressional Rescissions							-0	0.372	
	Congressional Increases						0.014	1	.200	
	CDID (STTD Turne for						-0.814			
	SBIK/STIK Iransier						-0.904			
(0)	<u>Significant Program Changes:</u>									
	C. Performance Metrics (U) Under Development.									
				R-1 Line Item	n No. 14					
				Page-1	of 8				Exhibit R-2 (PE 0602602F)
				UNCLASS	SIFIED					

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	cation			DATE	February	2008
				P	E NUMBER AND	TITLE	unitions	PROJECT NUM	BER AND TITLE	Technology
02 7		EV 2007	EV 2008	EX 2000	EV 2010		EV 2012	EV 2012		Technology
	Cost (\$ in Millions)	Actual	F 1 2008 Estimate	F 1 2009 Estimate	F1 2010 Estimate	FI 2011 Estimate	FI 2012 Estimate	F 1 2015 Estimate	Complete	Total
206	Advanced Guidance Technology	18,493	17.778	17.982	19.171	19.206	18.354	19.299	Continuing	TBD
2000	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	100
an	A Mission Description and Budget Item	Justification								
(0)	This project investigates, develops, and eva project includes development of advanced simulations. Project payoffs include: adve survivability; improved reliability and affo	aluates conventi guidance includ erse-weather and rdability; and in	onal munitions ing terminal se l autonomous p nproved surviv	advanced guid eekers, navigati precision guida ability and effe	lance technolog on and control nce capability; ectiveness of co	gies to establish signal and pro increased num nventional wea	n technical feas cessing algorit ber of kills per apons.	sibility and mili hms, and guida sortie; increase	tary utility. Th nce and contro ed aerospace ve	is l hicle
an	B Accomplishments/Planned Program	(\$ in Millions)					FY	2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Investigate and devel	lop advanced gu	idance compo	nent technologi	es for adverse	weather and	<u></u>	6.712	5.621	5.080
 autonomous seekers for air-delivered munitions, such as detectors and detector arrays, receiver electronics, signal pre-processing, target recognition, spatial target characteristics, optics, and low-cost beam scanning and shaping technologies. These technologies will enable the development of next generation seekers that will increase a weapon's kill probability, reduce pilot workload, and enhance sortie effectiveness. (U) In FY 2007: Further improved and tested components in laser ranging seeker to provide "single-shot" imaging. Conducted further fabrication of an optical seeker that uses multi-discriminate signatures to improve targeting obscured targets. Used ground test data to further augment the shape signatures in the automatic target acquisition algorithms to add laser multi-discriminate signatures. (U) In FY 2008: Test and demonstrate in a lab environment test components for laser ranging seeker to 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. 										
	useful targets. Test and demonstrate an optical seeker that uses multi-discriminate signatures to improve targeting obscure targets. Refine SAR System simulation. Begin developing a multi mode seeker that provides improved performance in two wavelength bands.									
(U) (U)	MAJOR THRUST: Investigate and devel munitions to include nonlinear controllers segmentation modules, and micro-electron path to target, increase stand off ranges, in enhance strike aircraft effectiveness and s	lop advanced na s, biomimetic gu mechanical gyro mprove resistano urvivability.	vigation and co idance, clutter os. These techn ce to Global Po	ontrol technolo rejection modu nologies will al ositioning Syste	gies for air-del ales, detection a low a more eff em (GPS) jamn	ivered and icient flight aing, and		3.800	3.300	3.455
Pro	ect 2068			R-1 Line Item Page-2	n No. 14 of 8				Exhibit R-2a (PE 0602602F)

Exhibit R-2a, RDT&E Project Just	ification	DA	February	2008
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT N 2068 Adv a	UMBER AND TITLE	e Technology
 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) In FY 2007: Further developed navigation and guidance techniques to autonomously weapons without location information from GPS. Further developed small agile veh Applied neuro-physiology of insects to guide small vehicles to moving targets in an evaluated navigation systems within GPS jamming environments. 	y guide cooperative robotic icle guidance to avoid obstacles. urban-like environment. Further	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2008: Test navigation and guidance techniques to autonomously guide cooper location information from GPS. Continue applying neuro-physiology of insects to g targets in urban like environments. Continue novel evaluating navigation system with environments. Investigate using data links to provide target location updates for pre- sensitive targets.	rative robotic weapons without uide small vehicles for moving hin GPS jamming cision strike against mobile, time			
(U) In FY 2009: Continue applying the neuro-physiology of insects to guide small vehic urban-like environments. Continue evaluating navigation systems within GPS jamm utility data links to provide target location updates for precision strike against time se guidance navigation and control algorithms for engaging high agility, reduced signat technologies applicable to indoor navigation within facilities.	les to moving targets in ing environments. Evaluate ensitive targets. Investigate ure targets. Investigate			
 (U) (U) MAJOR THRUST: Investigate and develop advanced optical and digital processors classification, and identification algorithms for improved seeker performance to allow autonomy. Continue developing highly innovative concepts and approaches in guida will deny an enemy the ability to hide or camouflage a target, while also decreasing a second second	and target detection, w greater air-delivered weapon ince and control. These seekers aircrew workload.	3.109	3.570	3.851
 (U) In FY 2007: Investigated particular target attributes using biomimetic principles. Determined theory models. Further evaluated contractor developed optic-flow algorithms. (U) In FY 2008: Verify biomimetic models through simulation. Continue developing period. Develop an optical flow ophenced seeker. 	eveloped polarization behavior plarization behavior theory			
 (U) In FY 2009: Continue verifying biomimetic models through simulation and field tes models through simulation. Conduct tests on an optical flow enhanced seeker. (U) 	ting. Verify polarization theory			
 (U) MAJOR THRUST: Investigate and develop detailed six-degree-of-freedom and hard including synthetic aperture radar, automatic target recognition, and biomimetic procinclude trajectory optimization algorithm and polarization sensing and models to ana components that will enable requirement studies, design iteration and evaluation, and These simulations will shorten development time, reduce development costs, and procinclu) In FY 2007: Further refined the set of interoperable simulations, validating the reusal 	dware-in-the-loop simulations essing. Technologies also lyze guided munitions and their l experiment risk reduction. wide more effective munitions. able aspect, to evaluate emerging	4.872	5.287	5.596
R-1 Line It Project 2068 Page	em No. 14 3 of 8		Exhibit R-2a	(PE 0602602F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUDG 02 A	ET ACTIVITY pplied Research				PE NUMBER A 0602602F C	ND TITLE	lunitions	PROJECT NUM 2068 Advan	BER AND TITLE	e Technology
(U) (U)	B. Accomplishments/Planned Pro munitions technologies. Improved environment. Developed a set of re- standardized components using star In FY 2008: Continue refining the emerging munitions technologies. scene simulation. Investigate laser hardware-in-the-loop testing.	egram (\$ in Mil existing multi-s eusable modeling ndard commerci set of interopera Update and test radar (LADAR)	lions) pectral phenom g tools to allow al products. ble simulations multi-spectral p scene generation	enology models munition simula s, validating the phenomenology on to demonstra	and evaluate in ations to be built reusable aspects models and eval te a feasible proj	a synthetic scene from , to evaluate uate via syntheti fection system fo	e c or	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	In FY 2009: Continue refining the Integrate and test updates for multi simulation. Continue the investigat Total Cost	set of interopera -spectral phenor ion of a LADA	ble simulations menology mode R scene generat	s to evaluate eme els and evaluate ion capability fo	erging munitions updated results v or hardware-in-th	technologies. via synthetic scente- ne-loop testing.	ne	18.493	17.778	17.982
(U) (U) (U)	C. Other Program Funding Summ 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.	hary (\$ in Millio FY 2007 Actual	<u>PMS</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>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Proje	ect 2068			R-1 Line Pag	e Item No. 14 ge-4 of 8 226				Exhibit R-2a	(PE 0602602F)

	Exhibit R-2a, RDT&E Project Justification									2008
BUDO 02 A	GET ACTIVITY pplied Research			P 0	E NUMBER AND	TITLE	initions	PROJECT NUME 2502 Ordnan	BER AND TITLE	ЭУ
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2502	2 Ordnance Technology	41.657	40.854	37.981	41.610	39.519	38.284	39.860	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U)	(J) <u>A. Mission Description and Budget Item Justification</u> This project investigates, develops, and evaluates conventional ordnance technologies to establish technical feasibility and military utility to include technologies for advanced conventional weapon dispensers, submunitions, safe and arm devices, fuzes, explosives, warheads, and weapon airframe and carriage technology. The project also assesses the lethality and effectiveness of current and planned conventional weapons technology programs and assesses target vulnerability. The payoffs include: improved storage capability and transportation safety of fully assembled weapons; improved warhead and fuze effectiveness; improved submunition dispensing; low-cost airframe/subsystem components and structures; and reduced aerospace vehicle and weapon drag.									
ത	B. Accomplishments/Planned Program	(\$ in Millions)					FY	2007	FY 2008	FY 2009
(U) (U) (U) (U) (U)	 (U) B. Accomplishments/Planned Program (\$ in Millions) (U) MAJOR THRUST: Investigate and develop high fidelity analytical tools, such as computational mechanics models for predicting weapons' effects and assessing target vulnerability. These analysis tools will reduce air-delivered munitions development costs and provide weapons that can generate maximum lethality against a given target class. (U) In FY 2007: Modeled damage to buildings caused by direct weapon effects. Improved methods for predicting damage caused by detonation of penetrating warheads in a variety of materials. Developed a model to predict the vulnerability of protected assets in deep underground facilities. (U) In FY 2008: Continue modeling damage to buildings caused by direct weapon effects. Develop capability to apply first principles computational tools to the design and evaluation of new munitions concepts. Identify high payoff technologies for defeating mobile targets. Apply system level analysis tools to identify high payoff technologies for defeating mobile targets. 									8.582
 (U) (U) MAJOR THRUST: Investigate and develop more efficient, affordable explosives including multi-phase blast explosives, cast and cure high energy composite explosives, and nano-scale metal fuels that 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. (U) In FY 2007: Further developed highly energetic material with twice the power density of conventional explosives by delivering a modeling and simulation capability for enhanced blast materials. Developed energetic liner technology to enhance blast output yet improve the insensitive munition attributes of the weapon system. Demonstrated 										6.700
Droi	performance of cast/cure PBX using advan	nced materials,	plasticizers, an	d formulation t R-1 Line Item	techniques. n No. 14				Exhibit D 2c /	
Pro	egi 2002			Page-5	UI 0 ,				EXHIDIT R-28 (F	-E UOU20U2F)

	Exhibit R-2a, RDT&E Project Justification February 2008								
BUDO 02 A	GET ACTIVITY F pplied Research C	PE NUMBER AND TITLE D602602F Conventional Munitions	PROJECT N 2502 Ordr	UMBER AND TITLE	gy				
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Continue developing highly energetic material with twice the power dens by formulating advanced energetic materials. Evaluate the sensitivity and detonation p design processes for new energetic formulations. Characterize the chemical reaction k materials to develop a materials properties database.	sity of conventional explosives performance and develop cinetics of new energetic	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>				
(U)	In FY 2009: Continue developing highly energetic material with twice the power den- by characterizing advanced explosive formulations. Evaluate the sensitivity and detor process of new energetic materials. Continue developing a materials properties databa- reaction kinetics.	sity of conventional explosives nation performance and develop ase characterizing chemical							
(U) (U)	MAJOR THRUST: Investigate and develop advanced fuze technologies for air-deliver commercially available micro-mechanical systems, shock-hardened fuzes, low energy modular firing systems for advanced single-point initiation, switches, capacitors, power components. These advanced fuze technologies will enhance lethality through precise above, or below the surface to increase weapon safety and tactical performance, while procurement costs and system supportability requirements.	7.050	5.600	6.000					
(U)	In FY 2007: Further developed a miniaturized fuze to provide safe and arm, burst poi initiator in a four cubic inch package. Further developed a wireless communication s munition. Continued to develop a waveform agile fuze to defeat smart jamming devic	nt sensor and low power ystem to fuze a hard target res.							
(U)	In FY 2008: Test a miniaturized fuze to provide safe and arm, burst point sensor and a cubic inch package. Complete static and sled testing of a wireless communication syst munitions. Complete development of a waveform agile fuze to defeat smart jamming, warheads to initiate explosives.	low power initiator in a four tem to fuze a hard target Begin investigating novel							
(U)	In FY 2009: Demonstrate a miniature fuze that provides safe and arm, burst point sen four cubic inch package. Continue investigating novel methods to initiate explosives. components to transmit bomb damage information.	sor and low power initiator in a Begin investigating miniature							
(U)									
(U)	MAJOR THRUST: Investigate and develop control and carriage technologies for orda air-delivered munitions in order to enhance weapon lethality. Examples of these technologies effectiveness by contributing to increased weapon load-out on strike aircraft and enhance Note: In FY 2007, funds are increased to support Battlefield Air Operations efforts.	nance packages for advanced nologies include high-energy will increase weapon systems nced sortie effectiveness.	13.859	12.152	8.800				
(U)	In FY 2007: Completed precision time-of-arrival investigation to defeat tunnel blast d	loors. Further investigated							
Proj	ect 2502 R-1 Line Ite Page-6	m No. 14 of 8		Exhibit R-2a (PE 0602602F)				

	TE February	2008			
budg 02 A	ET ACTIVITY oplied Research	PE NUMBER AND TITLE 0602602F Conventional Munitions	PROJECT N 2502 Ordr	UMBER AND TITLE	gy
(U)	B. Accomplishments/Planned Program (\$ in Millions) technologies for miniature cruise missile development. Completed the design stud low-cost multiple-shot munitions. Completed the initial investigation of nanotube structural weight of weapons. Further miniaturized the attack system to communic behind enemy lines. Further developed a covert video capability to collect and trat enemy targets.	ies for loitering, persistent, reinforced composites to reduce cate target aim point position from nsmit data to coordinate attack of	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Finish investigating technologies for miniature cruise missile develop attack system to communicate target aim point position from behind enemy lines. distribution capability to collect and transmit data to coordinate attack of enemy ta control technology to enable dual role air dominance missile technology. Begin to guided munitions.	oment. Finish miniaturizing the Field test a covert video rgets. Investigate reaction jet investigate the design of precision			
(U)	In FY 2009: Complete development of third spiral of covert video distribution cap coordinate attacks of enemy targets. Continue investigating reaction jet control for technology. Continue investigating the design of precision guided munitions by po- studies. Conduct research on dispensing technologies for aerospace applications.	bability and transmit data to r dual role area dominance missile erforming subsystem design trade			
(U) (U)	MAJOR THRUST: Investigate and develop advanced warhead kill mechanisms, s directional control and fragmenting ordnance, and application of reactive metals. ' characterization of the dynamic response of metals and geologic materials, adjusta distributed multi-point fire set to enhance air-delivered munition lethality. This en development of smaller munitions with effectiveness similar to current inventory v increase in aircraft load-out and sortie effectiveness.	such as adaptable warhead, The investigation includes ble yield ordnance packages, and hanced lethality supports the veapons with a corresponding	7.448	8.100	7.899
(U)	In FY 2007: Evaluated selected materials for high-speed penetrating weapons. Fu mechanisms for dual role, dual range missiles. Investigated micro damage technol with small robotic weapons.	rther developed focusing kill ogies to neutralize electronics			
(U)	In FY 2008: Continue evaluating selected materials for high-speed penetrating we against hard and combination targets. Begin investigating high strength next gener eventual goal of terradynamic steering. Evaluate shaped charges to defeat medium investigating micro-damage technologies to neutralize electronics with small robot velocity unmanned aerial vehicle (UAV) deliverable with strength to defeat harder submunition concept that can penetrate hardened target for agent defeat.	apons and the hard nose-caps ration warhead cases with the a and heavy armor. Continue ic weapons. Develop a small high ned targets. Develop a			
(U)	In FY 2009: Complete evaluation of selected materials for high-speed penetrating against hard and combination targets. Continue investigating high strength next ge	weapons and the hard nose-caps eneration warhead cases with the			
Proje	R-1 Line Pa	e Item No. 14 ge-7 of 8		Exhibit R-2a ((PE 0602602F)

		DATE	DATE February 2008								
BUD(02 A	GET ACTIVITY Applied Research				PE NUMBER A 0602602F C	ND TITLE Conventional M	lunitions	PROJECT NUM 2502 Ordnar	CT NUMBER AND TITLE Drdnance Technology		
(U)	B. Accomplishments/Planned Pre eventual goal of terradynamic steer Continue investigating micro-dama developing a small high velocity U submunition technology that provis new mechanisms for defeating age	ogram (\$ in Mil ring. Continue e age technologies AV deliverable de agent defeat r nt defeat targets.	llions) evaluation of sha to neutralize ele with strength to nechanisms aga	aped charges to o ectronics with su defeat hardened inst hardened ta	defeat medium a mall robotic wea l targets. Contin rgets. Begin inv	nd heavy armor. pons. Continue ue investigating estigations into	EY	<u>7 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U)	CONGRESSIONAL ADD: Advar In FY 2007: Not Applicable. In FY 2008: Conduct Congression Initiative.	nced Nanotube M ally-directed res	Aicro-Munition	Weapon Techno dvanced Nanotu	ology Initiative. be Micro-Muniti	ion Technology		0.000	1.192	0.000	
(U) (U)	Total Cost						2	41.657	40.854	37.981	
(U) (U) (U) (U)	C. Other Program Funding Summ 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>nary (\$ in Millio</u> <u>FY 2007</u> <u>Actual</u>	ons) 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>	<u>FY 2013</u> Estimate	Cost to Complete	<u>Total Cost</u>	
Pro	ject 2502			R-1 Line Pac	e Item No. 14 ge-8 of 8 230				Exhibit R-2a (PE 0602602F)	
				UNCL	ASSIFIED						

PE NUMBER: 0602605F PE TITLE: DIRECTED ENERGY TECHNOLOGY

	Exhit	DATE	DATE February 2008								
BUDG 02 A	UDGET ACTIVITY PE NUMBER AND TITLE 2 Applied Research 0602605F DIRECTED ENERGY TECHNOLOGY										
	Cost (\$ in Millions)	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	Complete		
	Total Program Element (PE) Cost	48.487	56.915	62.871	90.216	75.717	93.720	99.591	Continuing	TBD	
4866	Lasers & Imaging Technology	24.383	35.753	36.633	48.766	42.530	51.926	54.866	Continuing	TBD	
4867	Advanced Weapons & Survivability Technology	14.934	16.290	19.964	29.042	20.037	26.627	29.472	Continuing	TBD	
55SP	Laser and Imaging Space Tech	9.170	4.872	6.274	12.408	13.150	15.167	15.253	Continuing	TBD	
PE in (U)	 PE in order to more effectively manage the efforts. (U) <u>A. Mission Description and Budget Item Justification</u> This program covers research in directed energy technologies, primarily lasers and high power microwaves. In lasers, this research includes moderate to high power lasers (solid state and chemical) and associated optical components and techniques. In advanced weapons, this program examines technologies such as narrowband and wideband high power microwave devices and antennas. Vulnerability/lethality assessments of representative systems are done for both areas. Note: In FY 2008, Congress added \$2.4 million for Ceramics for Next-Generation Tactical Laser Systems. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary technologies. (U) B. Program Change Summary (\$ in Millions) 										
							<u>FY 2007</u>	<u>FY 2</u>	2008	<u>FY 2009</u>	
(U)	Previous President's Budget						50.019	54	.883	53.362	
(U)	Current PBR/President's Budget						48.487	56	.915	62.871	
(U)	Total Adjustments						-1.532	2	2.032		
(U)	Congressional Program Reductions							-0	.005		
	Congressional Rescissions							-0	.363		
	Congressional Increases							2	2.400		
	Reprogrammings						-0.534				
	SBIR/STTR Transfer						-0.998				
(U)	Significant Program Changes:										
	Funding was increased in FY 2009 for add	litional demons	trations leading	g to an earlier t	ransition of tac	tical directed en	nergy weapon t	echnologies.			
	C. Performance Metrics										
	Under Development.										
				R-1 Line Iter	n No. 15 of 14				Fxhihit R-2 (PF 0602605F)	
L		1		- age-1 0 221						00020001)	
				UNCLAS	SIFIED						

	Ext	hibit R-2a, F	RDT&E Pro	oject Justifi	ication			DA	February	2008		
BUDGET ACTIVITY 02 Applied Res	IDGET ACTIVITY PE NUMBER AND TITLE PE Applied Research 0602605F DIRECTED ENERGY 44 TECHNOLOGY								ROJECT NUMBER AND TITLE 866 Lasers & Imaging Technology			
	Cost (\$ in Millions)	FY 2007	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total		
4866 Lasers	& Imaging Technology	24 383	35 753	36 633	48 766	42.530	51 926	54.86	6 Continuing	TBD		
Ouantit	y of RDT&E Articles	0	0	0	0	0	0	0 1100	0	100		
Note: In FY 200	8, relay mirror technology effor	rts in Project 55	SP, Laser and	Imaging Space	Technology, tr	ansferred to Pr	oject 4866, La	sers and Ima	ging Technology,	within this		
PE in order to me	ore effectively manage the effor	rts.		0 0 1								
I his project engagement developmen beam contro modeling ar requirement military util	texplores the technical feasibility, and Global War On Terrorism at of: (1) compact, reliable, and ol systems to enhance laser beam and simulation and laboratory ex- ts unique to potential applicatio- ity and cost trade decisions.	n missions. Dev affordable laser m propagation a speriments to de ons. Develop an	to high power velop new tech r systems with and pointing an emonstrate trace id implement sy	asers and supp nologies, perfo good beam qua ad tracking over eability to key o ystem concept a	orting laser tec rm physics base ality, scalability r long distances concept perform assessment tool	nnologies for a ed modeling, ar to high power, in the atmosph nance parameter is supporting th	arcraft protection and evaluate net and high pote here. Emphasi ers, reliability, e definition of	on, force pro w materials t ential military s will be on t affordability laser system	tection, precision hat will enable utility; (2) optica using computer , and packaging concept performa	al and ance,		
(U) <u>B. Accom</u>	plishments/Planned Program	(\$ in Millions)					FY	<u>2007</u>	FY 2008	<u>FY 2009</u>		
 (U) MAJOR T. Technolog demonstrate (U) In FY 2007 efficiency a Continued tactical pla in relevant are favorab Developed Demonstrate (U) In FY 2008 developme Perform fu scenarios. models. C suitable pa 	HRUST: Develop solid state la ies include fiber lasers and bulk tions leading to an earlier transi 7: Designed and developed lase and reliability. Performed testi development of solutions to ae tform disturbance mitigation. If scenarios. Validated vulnerabi- ble in terms of size, weight, effi- the most promising solid state ated "eye-safe" wavelength solid 8: Refine laser sources to obtai ent of system-level solutions to orther lethality assessment studi Continue coupon-level and mic- ontinue to scale electric lasers of rameters in terms of size, weight	aser technologie k solid state lase ition of tactical er sources for ja ing of ultra-shor ero-optical issue Performed addit ility assessment iciency, affordal laser technolog d state laser tech in higher efficie aero-optical issue tes to assess the d-scale demons up to the weapo ht, efficiency, a	es for airborne ers. Funding w laser weapon to umming/damag t pulse laser so s on airborne p tional lethality models. Refin bility, and field ties for scaling hnology for des ncies and impr ues involving a effectiveness of tration experim- ons class power ffordability, re	tactical and stra vas increased in echnologies. ing optical three ources to evalua- blatforms. Invest assessment stud- ned technologie lability for tacti to the weapons signator and illu- ove ruggedness hirborne tactical of the various la- nents to validate level. Refine to liability, mainta	ategic application FY 2009 for active eats, focusing on the potential app stigated technologies of various es to obtain arch ical laser weapon a class power le uminator applic s of designs. Co l laser weapon a aser concepts in e vulnerability a technologies in ainability, supp	ons. dditional n increased blications. logies for laser concepts nitectures that on applications. vel. cations. ontinue applications. relevant assessment effort to obtair ortability,	1	2.920	15.366	17.903		
Project 4866				R-1 Line Iten Page-2 c	n No. 15 of 14				Exhibit R-2a (PE 0602605F)		

	Exhibit R-2a, RDT&E Project Justific	DA	TE February	2008	
BUD(02 A	JET ACTIVITY PE pplied Research 060 TE	NUMBER AND TITLE 02605F DIRECTED ENERGY CHNOLOGY	PROJECT N 4866 Lase	echnology	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Improve design of laser sources for aircraft self-protection. Perform damage real or simulated systems. Use test results to verify models and assess laser effectiveness. Demonstrate system-level beam control solutions to aero-optical issues of tactical laser v airborne platforms. Continue to assess the effectiveness of the various laser concepts in Continue to scale electric lasers up to the weapons class power level. Pursue higher pow concepts. Develop architectures that are suitable in terms of size, weight, efficiency, affe	ge/vulnerability tests against s/system vulnerabilities. weapons applications on relevant scenarios. ver "eye-safer" electric laser ordability, reliability,			
	maintainability, supportability, environmental acceptability, and ruggedness for the next-	-generation applications.			
(U) (U)	MAJOR THRUST: Develop chemical, gas, and hybrid laser technologies (i.e. new fuel techniques and nozzle designs) for scalable, high energy laser devices with improved ef	chemistry, fuel regeneration	4.735	6.013	5.490
(U)	In FY 2007: Continued to investigate scaling of high-performance oxygen generator cor applications. Evaluated iodine injection schemes for oxygen generators. Evaluated and laser technologies demonstrated in FY 2006. Pursued scaling chemical-electric hybrid la potential for power scaling and component size and weight reduction.	acepts for airborne laser refined advanced chemical aser technologies that offer			
(U)	In FY 2008: Demonstrate enhanced-performance singlet delta oxygen generator coupled nozzle concepts for airborne laser applications, including advanced fuel chemistries. Co	d with advanced ejector ntinue scaling path			
(U)	In FY 2009: Refine high-performance singlet delta oxygen generator and advanced eject airborne laser applications based on results of previous demonstration. Conduct real-wor for enhanced chemical and electric discharge oxygen-iodine lasers and diode-pumped at	tor nozzle concepts for rld condition demonstrations omic lasers.			
(U) (U)	MAJOR THRUST: Develop optical and imaging technologies for advanced beam contro compensation, and pointing and tracking for future optical imaging/laser systems. Note: technology efforts previously performed in Project 55SP, Laser and Imaging Space Tech placed here to more effectively manage the efforts. Funding was increased in FY 2009 f leading to an earlier transition of tactical laser weapon beam control technologies.	ol, atmospheric In FY 2008, relay mirror mology, within this PE were for additional demonstrations	4.971	11.989	13.240
(U)	In FY 2007: Developed system-level solutions to aero-optical issues involving tactical la platforms and acquired adaptive optics system for wind tunnel aero-optics disturbance m Investigated technologies for tracking in clutter and tactical platform disturbance mitigat technologies for transition from laboratory to field testing. Investigated advanced adapti	aser applications on airborne itigation testing. ion. Developed selected ve optics techniques.			
Pro	R-1 Line Item N Page-3 of	No. 15 14		Exhibit R-2a	(PE 0602605F)

		DATE	DATE February 2008									
BUD(02 A	GET ACTIVITY Applied Research				PE NUMBER A 0602605F D TECHNOLC	ND TITLE DIRECTED ENE DGY	RGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technol				
 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) In FY 2008: Integrate adaptive optics hardware in wind tunnel tests to measure and characterize aero-optical disturbances. Develop and analyze advanced tactical beam control architectures and critical beam control components, such as inertial reference systems and trackers. Begin development of lightweight optics and advanced tracking techniques and technologies. Complete sub-system fabrication in order to conduct a low-power demonstration. Assess alternatives to improve compensation in long horizontal path propagation. Begin development of advanced adaptive optics techniques. Continue development of silicon carbide fast steering mirror and complete inner gimbals for tactical relay mirror demonstrator. 									<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Complete demonstr tactical laser weapons systems in technologies for an end-to-end fi jitter reduction and improved tra- laser systems on large aircraft. S horizontal path propagation. Con optics on both receive and transm	ation of system-lev wind-tunnel envir eld demonstration cking for tactical la elect improved con ntinue developmen nit mirrors of tactic	vel solutions for onment. Implet of precision tact isers. Analyze in npensation tech t of advanced au al relay mirror	aero-optical dis ment advanced p tical laser beam impact of incorp niques for labor daptive optic tec demonstrator.	tortions associa blatform disturba control. Demor orating high-po- atory demonstra hniques. Demo	ted with airborne ance reduction astrate advanced wer solid state ations of long nstrate adaptive						
(U) (U) (U)	CONGRESSIONAL ADD: Cera In FY 2007: Continued to refine effort to secure a domestic source improved thermal, mechanical, a In FY 2008: Continue developm In FY 2000: Nat Applicable	amics for Next-Ger ceramic process as e for required nano nd optical perform ent of advanced ce	neration Tactica nd scaled up pro powders. Cont ance necessary ramic materials	l Laser Systems ocess to commer inued to increase for use in high e for solid state la	ccial grade. Broa e size of laser m nergy lasers. asers.	adened research aterials with		1.757	2.385	0.000		
(U) (U)	Total Cost							24.383	35.753	36.633		
(U) (U) (U) (U)	C. Other Program Funding Sur Related Activities: PE 0601108F, High Energy Laser Research Initiatives. PE 0602890F, High Energy	nmary (\$ in Millio <u>FY 2007</u> <u>Actual</u>	ons) 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>	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete	<u>Total Cost</u>		
Pro	R-1 Line Item No. 15 Project 4866 Page-4 of 14 234								Exhibit R-2a	(PE 0602605F)		

	Exhibit R-2a, RDT&E F	DATE February 2008	
BUD 02 /	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology
(U)	C. Other Program Funding Summary (\$ in Millions)		
(U)	PE 0603444F, Maui Space		
	Surveillance System.		
(U)	PE 0603605F, Advanced		
	Weapons Technology.		
(U)	PE 0603924F, High Energy		
	Laser Advanced Technology		
	Program.		
(U)	PE 0602120A, Sensors and		
	Electronic Survivability.		
(U)	PE 0602307A, Advanced		
	Weapons Technology.		
(\mathbf{U})	PE 0602624A, weapons and		
	Munitions Technology.		
(0)	PE 0005004A, weapons and Munitions Advanced		
	Technology		
(II)	PE 0602114N Power Projection		
(0)	Applied Research		
an	PF 0602702F Tactical		
(0)	Technology		
Л	PE 0603175C. Ballistic Missile		
(0)	Defense Technology.		
ധ	PE 0603883C. Ballistic Missile		
(-)	Defense Boost Phase Segment.		
(U)	PE 0602651M, Joint Non-Lethal		
Ì Í	Weapons Applied Research.		
(U)	PE 0603651M, Joint Non-Lethal		
	Weapons Technology		
	Development.		
(U)	This project has been		
	coordinated through the		
		D 4 Line Item No. 45	
Pro	ject 4866	Page-5 of 14	Exhibit R-2a (PE 0602605F)
		235	, ,

Exhibit R-2a, RDT&E	DATE February 2008		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4866 Lasers & Imaging Technology	
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Reliance 21 process to harmonize efforts and eliminate duplication.			
(U) <u>D. Acquisition Strategy</u> Not Applicable.			
Project 4866	R-1 Line Item No. 15 Page-6 of 14	Exhibit R-2a (PE 0602605F)	

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 02 A f	BUDGET ACTIVITY 12 Applied Research				PE NUMBER AND 0602605F DIR FECHNOLOG	ECTED ENER	RGY	PROJECT NUME 4867 Advanc Survivability	&	
	Cost (\$ in Millions)	FY 2007 Actual	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	14.934	16.290	19.964	29.042	20.037	26.627	29.472	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	A. Mission Description and Budget Item This project explores high power microwar support a wide range of Air Force missions effect can often be applied covertly with no as large and small air defense and comman systems to HPM weapons, HPM weapon to	a Justification we (HPM) and o s such as the pot o collateral struct d and control sy echnology asses	ther unconvent ential disruption tural or humar estems. This present for spec	tional weapon on and degrada n damage. Tar roject also prov ific Air Force	concepts using tion of an adver geted capabilition vides for vulner missions, and H	innovative tech rsary's electron es include loca ability assessm PM weapon le	nnologies. Tec ic infrastructur l computer and ents of represe thality assessn	chnologies are d re and military of communicatio entative U.S. str nents against for	eveloped that capability. This n systems, as we ategic and taction reign targets.	ell cal
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Investigate and devel support multiple Air Force applications su In FY 2007: Conducted measurements us Developed a command and control system nanotechnology to reduce the HPM source wideband testbed. Developed an engineer used to conduct laboratory experiments for In FY 2008: Continue testing of the comp to improve the compact HPM source and platform. Develop a compact wideband to	(\$ in Millions) lop technologies ich as the disrup sing the compace in for the compace e weight and size ring model of a or applications s pact repetitively conformal anter arget-under-tree	for narrowbar otion of electro t repetitively p ct airborne plat e. Conducted compact widel uch as target u pulsed gigawa na such that th s identification	nd and widebar nic systems an ulsed gigawatt form HPM tes field tests to cl band target ide nder trees. att-class HPM of hey can be inten n unit that can b	nd HPM compo d subsystems. -class HPM test tbed. Investiga haracterize and ntification syste demonstration u grated into an a be used to condu	nents to bed. ted to evaluate the em that can be unit. Continue irborne uct laboratory	<u>F</u> Y	<u>7 2007</u> 3.915	<u>FY 2008</u> 4.821	<u>FY 2009</u> 4.445
(U)	functional testing. Perform design studies In FY 2009: Enhance the compact repetit conformal antenna and command and com and high voltage switch and demonstrate delivering gas into interaction region of H determine new HPM waveforms that can	s for disk genera ively pulsed gig trol system for the effectivenes IPM tubes. Inve be optimized fo	a compact flux tors to further awatt-class HI the compact HI s during field t estigate HPM c r a cyber warfa	reduce the size PM testbed. In PM testbed. Ir ests. Develop concepts related are application.	e of single shot tegrate and den nprove the wide apparatus capal d to cyber warfa	devices. nonstrate the eband antenna ble of correctly are and				
(U) (U)	MAJOR THRUST: Develop and use the technologies against representative air and	ability to assess d ground system	the effects/lethes. Develop an	hality of HPM d apply sophis	directed energy ticated models	weapon to enhance the		4.378	5.315	5.607
Proje	ect 4867			R-1 Line Iter Page-7	m No. 15 of 14 7				Exhibit R-2a (F	PE 0602605F)

	Exhibit R-2a, RDT&E Proje	DATE February 2008				
BUDC 02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TI 4867 Advanced Weap Survivability Technol		ntle pons & logy	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	development of HPM and related technology. In FY 2007: Predicted susceptibilities of relevant electronic systems based experiments on the systems to verify model accuracy and compare predicti required. Identified and mitigated platform/system susceptibilities to HPM capability for HPM. Conducted susceptibility testing of electronic targets. susceptibility for military systems against both domestic and foreign sourc electromagnetic codes with thermal and electron transport codes for HPM model for high field regions. Investigated improved material physics mod	d on model and manufacturer. Conducted ions with experiments. Adjusted models as I. Refined battle damage assessment Identified and mitigated HPM res. Validated integration of sources and components. Applied plasma els. Initiated development of automatic				
(U)	refinement for HPM system design. In FY 2008: Incorporate elemental modeling into predictive code for use is susceptibility testing of electronic targets. Apply hardening techniques and Identify and mitigate HPM susceptibility for military systems of interest to preliminary battle damage assessment technologies for use with HPM. Ap enhancement. Continue to investigate and integrate improved material modevelopment of automatic design enhancement.	in targeting and war gaming. Continue d technology to identified platforms. o HPM sources. Continue to refine oply virtual modeling for HPM system odels into HPM tube simulations. Continue				
(U)	In FY 2009: Apply physics-based understanding and models to predict tar engagement model. Continue verification and validation of engagement m mitigation effort to harden multiple USAF systems. Explore propagation of discharge protection devices on circuit boards and provide hardening recon Verify linkages between components in an HPM system. Integrate, verify secondary, and thermal emission models.	rget effects and incorporate results into an nodel software. Expand microwave effects of microwave signals through electro-static mmendations to chip manufacturers. , and improve material models for field,				
(U) (U)	MAJOR THRUST: Investigate HPM technologies that support offensive a applications, including non-lethal counterpersonnel applications, made post future aircraft. Funding was increased in FY 2009 for additional demonstratical HPM weapon technologies.	and force protection airborne tactical ssible by the increased power available on rations leading to an earlier transition of	6.641	6.154	9.912	
(U)	In FY 2007: Developed HPM source materials and assessed applicability supporting ruggedized high power airborne and counter-improvised explose system source code to allow multiple options for high power subsystem contechnologies. Refined existing beam control/antenna concepts to meet airbitsues related to propagation, breakdown, and radomes. Researched, studied	of solid state subsystem designs sive device systems. Extended HPM omponents. Matured relativistic magnetron porne requirements including addressing ed, and identified technology or data				
Proj	ect 4867	R-1 Line Item No. 15 Page-8 of 14 238		Exhibit R-2a	(PE 0602605F)	

		Exhibit R-2	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUDO 02 A	GET ACTIVITY pplied Research			PE NUMBER A 0602605F D TECHNOLO	ND TITLE IRECTED ENE IGY	ERGY	PROJECT NUM 4867 Advan Survivability	T NUMBER AND TITLE Advanced Weapons & ability Technology		
(U)	B. Accomplishments/Planned Pr (effects, safety, stabilization, enga	cogram (\$ in Mill gement, etc.) requ	lions) uirements impac	cting overall airt	oorne conceptual	l approach.	<u>F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Continue developmed designs supporting ruggedized hig results from the HPM system sour Continue to refine antenna concept explosive device systems includin development of full power non-let	the techniques. And of HPM source the power airborne to code that reflect to to meet airborn g addressing issue thal test source.	e materials and and counter-im cts multiple opt he requirements es related to pro Complete millin	assess applicabil provised explos ions for high po- for counter elec opagation, break neter wave diagn	ity of solid state ive device system wer subsystem c tronics and coun down, and radon ostic techniques	e subsystem ms. Analyze the components. ater-improvised nes. Continue s.	2			
(U) (U)	In FY 2009: Demonstrate maturin supporting ruggedized high power enhanced options for high power Demonstrate the antenna design th counter-improvised explosive dev radomes. Complete development work and technology studies for a	ng HPM source m airborne and cou subsystem compo- nat best meets airb ice systems includ of full power non irborne implemen	aterials and the inter-improvised nents based on borne requiremend ding addressing i-lethal test sour itation.	applicability of d explosive device the results of the ents for counter en- issues related to rec. Continue no	solid state subsy ce systems. Der HPM system so electronics and propagation, br on-lethal beam co	/stem designs nonstrate the ource code. reakdown, and ontrol/antenna		14.024	16 200	10.064
(\mathbf{U})								14.954	10.290	19.904
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u> <u>FY 2007</u> <u>Actual</u>	ons) <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>	Total Cost
(U) (U)	Related Activities: PE 0602202F, Human Systems Technology.									
(U)	PE 0603605F, Advanced Weapons Technology.									
(U)	PE 0602120A, Sensors and Electronic Survivability									
(U)	PE 0602624A, Weapons and Munitions Technology									
(U) (U)	PE 0602114N, Power Projection PE 0602651M, Joint Non-Lethal Weapons Applied Research.									
Proj	ect 4867			R-1 Line Page	Item No. 15 e-9 of 14				Exhibit R-2a	(PE 0602605F)

Exhibit R-2a, RDT&	DATE February 2008	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 4867 Advanced Weapons & Survivability Technology
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> (U) PE 0603851M, Nonlethal Weapons (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. 		
Project 4867	R-1 Line Item No. 15 Page-10 of 14 240	Exhibit R-2a (PE 0602605F)

	ExI	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008	
BUDGET ACTIVITY PE T 02 Applied Research 060 TEC					YE NUMBER AND 602605F DIR ECHNOLOG	ECTED ENE	RGY	PROJECT NUME	ROJECT NUMBER AND TITLE 55P Laser and Imaging Space Tech		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
55SF	P Laser and Imaging Space Tech	9.170	4.872	6.274	12.408	13.150	15.167	15.253	Continuing	TBD	
	Quantity of RDT&E Articles	0	0			0		0			
(U) (U)	A. Mission Description and Budget Item Develop advanced, long-range, optical tecl pointing; large, lightweight optics; and opt high-energy laser weapons and update cata B. Accomplishments/Planned Program	Justification hnologies such a tical coatings tha alogued satellite	as advanced be at support futur s.	am control; bea re space-object	am acquisition, imaging systen	tracking, and particular teaching in the provident teaching in the provident teaching in the provided teaching in the provided teaching is a set of the provided teaching in the provided teaching is a set of the	pointing; adapt vulnerability o	tive optics; dual of satellites to th	line-of-sight e effects of FY 2008	FY 2009	
(U) (U)	MAJOR THRUST: Develop advanced, le acquisition, tracking, and pointing; adapti coatings that support future space-object i In FY 2007: Completed design for next g propagation to determine parameters for r carbide mirrors technology. Investigated turbulence. Began procurement of long le telescopes for integration into a relay mirr mirror system. Continued development of development of advanced wavefront cont	ong-range, optic ive optics; dual imaging system generation high relay mirror syst designs for rela ead optical com ror payload. De of phased array t rol techniques.	cal technologie line-of-sight po s. power relay mi ems. Continue y mirrors to en ponents to incl eveloped compa- ransceivers for	s such as advar pinting; large, li irror. Performe ed the developr hance propagat ude transmittin act lightweight high-resolution	nced beam contr ightweight opti- ed optical analy ment of lightwe tion of laser bear og and receiving electrostatic de n imaging. Con	rol; beam cs; and optical sis of beam ight silicon am through g beam director formable ntinued		7.312	2.661	3.551	
(U) (U)	In FY 2008: Investigate the bandwidth, n correlate the attributes to user needs to ind system level experiment. Continue devel simultaneous imaging and beam projection spatial light modulators for several imaging In FY 2009: Complete testing of electross determine maturity and utility for Air For	novement, and a clude aero-optic opment of a low on with wide field ng applications. static deformable ree applications.	esolution limit compensation power phased d of regard bea e mirror and sp Develop and	s of various ad , and demonstr l array transceiv am steering ele vatial light mod demonstrate a l	aptive optics co ate a selected co ver experiment ments. Continu ulator technolo high energy fibe	oncepts, oncept in a that includes a research into gies to er laser phased)				
(U) (U)	array transceiver system level brassboard phase compensated transmitted beams, an MAJOR THRUST: Assess the vulnerabi catalogued satellites.	concept that ind ad shared transm lity of U.S. sate	cludes high resolution resolution and the cludes high resolution resolution and the cludes to the effective sub-	olution pupil pl apertures. ects of high-end	lane imaging, p	hase retrieval,	2	1.858	2.211	2.723	
Proje	ect 55SP			R-1 Line Iten Page-11 241	n No. 15 of 14				Exhibit R-2a (I	PE 0602605F)	

	E	xhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUD(02 A	BET ACTIVITY pplied Research			PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY			PROJECT NUMBER AND TITLE 55SP Laser and Imaging Space			
(U)	B. Accomplishments/Planned Progra	<u>am (\$ in Mil</u>	<u>lions)</u>				E	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2007: Developed and applied in vulnerability assessment. Continued to of laser illumination, tracking, and con aerospace systems to the effects of dire predictive avoidance analyses and prov improved performance of Laser Clearin									
(U)	In FY 2008: Explore new methods to characterization and assessment. Cont modeling tools, including results of last techniques. Assess the survivability ar weapons. Integrate developed space m Continue to improve and mature capab status of aerospace systems while work other users.	develop and inue to refine ser illuminati- nd vulnerabil naterial prope- bilities to rapi- king to begin	apply improved e assessment me on, tracking, an ity of evolving erties and aging dly fuse existin transition of th	algorithms and ethodology by in d compensated i aerospace system effects data and g sensor data to ese capabilities t	hardware for sa corporating new maging; and app ns to the effects algorithms into assess the opera to U.S. Strategic	tellite v data into plying new of directed energ assessments. ttional health and c Command and	ÿ			
(U)	 other users. (U) In FY 2009: Expand analysis capabilities to provide assessments of effects on aerospace systems from new and emerging directed energy concepts. Continue to refine and broaden assessment methodologies by incorporating new experimental data from laser illumination, tracking, and compensated imaging; results of space materials properties and aging analysis; and enhanced numerical techniques. Continue support of operational mission planning tools, algorithms, predictive avoidance, and space situational awareness by updating and transitioning databases and assessment capabilities. Integrate and test advanced optical and infrared sensor systems with 3.5 meter telescope and 									
(U)	Total Cost							9.170	4.872	6.274
(U)	C. Other Program Funding Summary	<u>y (\$ in Millio</u>	ons)			TH 2011			a	
		<u>FY 2007</u> Actual	<u>FY 2008</u> 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	Total Cost
(U)	Related Activities:	<u>netuu</u>	Diffinite	Listimate	Listimute	Listimate	Listimate	Listimate	<u>compiete</u>	
(U)	PE 0603444F, Maui Space									
a n	Surveillance Systems.									
(U)	PE 0603605F, Advanced									
(U)	PE 0601108F, High Energy									
Proj	ect 55SP			R-1 Line Page	tem No. 15 -12 of 14				Exhibit R-2a	(PE 0602605F)

	Exhibit R-2a, RDT&E	DATE February 2008	
BUD 02 /	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 55SP Laser and Imaging Space Tech
(U)	<u>C. Other Program Funding Summary (\$ in Millions)</u>		
	Laser Research Initiatives.		
(U)	PE 0602890F, High Energy		
	Laser Research.		
(U)	PE 0603924F, High Energy		
	Laser Advanced Technology		
	Program.		
(U)	PE 0603883C, Ballistic Missile		
	Defense Boost Phase Segment.		
(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 0602702E, Tactical		
	Technology.		
(U)	PE 0603175C, Ballistic Missile		
	Defense Technology.		
(U)	PE 0603883C, Ballistic Missile		
	Defense Boost Phase Segment.		
(U)	PE 0602651M, Joint Non-Lethal		
	Weapons Applied Research.		
(U)	PE 0602651M, Joint Non-Lethal		
	Weapons Applied Research.		
(U)	This project has been		
ĺ	coordinated through the		
		R-1 Line Item No. 15	
Pro	ject 55SP	Page-13 of 14	Exhibit R-2a (PE 0602605F)
		243	

Exhibit R-2a, RDT&E	DATE February 2008		
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602605F DIRECTED ENERGY TECHNOLOGY	PROJECT NUMBER AND TITLE 55SP Laser and Imaging Space Tech	
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Reliance 21 process to harmonize the efforts and eliminate duplication.			
(U) D. Acquisition Strategy Not Applicable.			
Project 55SP	R-1 Line Item No. 15 Page-14 of 14 244	Exhibit R-2a (PE 0602605F)	

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

	Exhit	DATE	February	2008						
BUDGE 02 Ap	BUDGET ACTIVITY PE NUMB 02 Applied Research 0602702						R AND TITLE			
	Cost (\$ in Millions)	FY 2007 Actual	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	125.791	121.417	109.492	123.122	109.536	124.772	127.275	Continuing	TBD
4519	Communications Technology	28.734	32.746	30.681	38.837	25.531	34.344	35.952	Continuing	TBD
4594	Information Technology	32.946	31.946	32.564	29.136	30.994	37.404	39.557	Continuing	TBD
5581	Command and Control (C2) Technology	48.236	39.620	36.256	46.508	44.126	43.062	41.917	Continuing	TBD
66SP	Space Optical Network Tech	15.875	17.105	9.991	8.641	8.885	9.962	9.849	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. FY 2008 funding totals do not include \$1.800 million FY 2008 GWOT requirements still pending Congressional consideration.

(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 2008, Congress added \$1.6 million for Adaptive Optics for Lasercom System, \$2.0 million for Compact Laser Terminal for Airborne Network Centric Warfare, and \$1.9 million for Cyber Attack Mitigation Lab. This program is Budget Activity 2, Applied Research, since it develops and determines the technologies.

R-1 Line Item No. 16	
Page-1 of 27	Exhibit R-2 (PE 0602702F)
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	Exhibit R-2, RDT&E B	Budget Item Justification	DATE February 2008							
BUD 02 /	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Contr	PE NUMBER AND TITLE 0602702F Command Control and Communications							
(U)	B. Program Change Summary (\$ in Millions)									
			FY 2007	FY 2008	FY 2009					
(U)	Previous President's Budget		128.680	116.705	105.496					
(U)	Current PBR/President's Budget		125.791	121.417	109.492					
(U)	Total Adjustments		-2.889	4.712						
(U)	Congressional Program Reductions			-0.011						
	Congressional Rescissions			-0.777						
	Congressional Increases			5.500						
	Reprogrammings		-1.913							
	SBIR/STTR Transfer		-0.976							
(U)	Significant Program Changes:									
	Not Applicable.									
	C. Performance Metrics									
	(U) Under Development.									
I										
		R-1 Line Item No. 16								
		Page-2 of 27		Exhibit F	R-2 (PE 0602702F)					
		246								
BUDGET ACTIVITY IPPE NUMBER AND TITLE PPE OLYMBER AND TITLE PEE OLYMBER AND TITLE </th <th>Ext</th> <th>nibit R-2a, F</th> <th>DT&E Pro</th> <th>ject Justifi</th> <th>ication</th> <th></th> <th></th> <th>DA</th> <th>February</th> <th>2008</th>	Ext	nibit R-2a, F	DT&E Pro	ject Justifi	ication			DA	February	2008
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Cost (\$ in Millions) FY 2007 Actual Fstimate FY 2008 Fstimate Fstimate FY 2010 Fstimate Fstimate FY 2010 Fstimate FStimate Fstimate <thf< th=""><th>BUDGET ACTIVITY 02 Applied Research</th><th></th><th></th><th>P 0 0</th><th colspan="3">PE NUMBER AND TITLE 0602702F Command Control and Communications</th><th colspan="3">PROJECT NUMBER AND TITLE 4519 Communications Technology</th></thf<>	BUDGET ACTIVITY 02 Applied Research			P 0 0	PE NUMBER AND TITLE 0602702F Command Control and Communications			PROJECT NUMBER AND TITLE 4519 Communications Technology		
Constraint Actual Estimate	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
4519 Communications Technology 28:74 32:746 30:881 58:87 25:53.1 34:344 35:59.2 Continuum 1111 Quantity of RDTE& Articles 0		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
Quantity or NOT ACE Attributes 01	4519 Communications Technology	28.734	32.746	30.681	38.837	25.531	34.344	35.95	52 Continuing	TBD
(1) A. <u>Mission Description and Bidget Item Instituction</u> (11) A. <u>Mission Description and Educed Item Instituction</u> The Air Force requires technologies will provide capabilities for en-oute and deployed distributed collaborative command, control, surveillance, reconnaissance and exploitation. A rapidly deployed force requires assured connectivity with reliable, responsive, affordable information exchange via all available communications modia. This project provides the technologies for: multi-level, secure, seamless networks; advanced communications processors; anti-jam and low probability of intercept techniques; lightweight, phased array antennas; and modular, programmable, low-cost software radios. It includes technologies for advanced processors and devices, advanced derwork protocols and services, intelligent communications management and control, advanced communications algorithms, and enabling communication signal processing techniques. EX 2007 FX 2008 EX 2009 (1) MAJOR THRUST: Develop assured and survivable information on perations for the Air Force. II.830 9.669 9.996 (10) In FY 2007: Completed development of capabilities or self-organizing, self-healing, autonomous networking. Developed and tested communications and sensor management functions for more effective woring target caploitation and fusion. Developed airborne content-based delivery networks (GBDN), synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and applied to extremely dynamic inferstructure and network platform mobility dictated by tactical aircraft. (11) In FY 2008: Continue development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Cont	Quantity of RD1&E Articles		0	0	0	0	0		0	
(U) B. Accomplishments/Planned Program (\$ in Millions) FY 2007 FY 2008 FY 2009 (U) MAJOR THRUST: Develop assured and survisable information and networking technologies enabling worldwide command, control, surveillance, and exploitation operations for the Air Force. 11.830 9.669 9.996 (U) In FY 2007: Completed development of capabilities for self-organizing, self-healing, autonomous networking. Developed policy-based network management technologies for real-time network response to changes in INFOCON levels. Developed and tested communications/resource network management functions for more effective moving target exploitation and fusion. Developed airborne content-based delivery networking (CBDN), synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and applied to extremely dynamic infrastructure and network/platform mobility dictated by tactical aircraft. 11.830 9.669 9.996 (U) In FY 2008: Continue development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Continue development of airborne CBDN, synergistic with the Joint Tactical Radio System Wideband Networking Yetrie Edware, and apply to extremely dynamic airborne nets. Continue design and development of airborne network work deliagen and development of cognitive networking technology that senses operating environment, learns application requirements, and intelligenty adapts network protocols. Initiate design and development of network operations and security capability to provide policy-based, mission-based, cross-domain, heterogeneous network quality of performance, security, configuration, and fault management in a net-centr	communication and networking technologics that en- communication and networking technologic reconnaissance and exploitation. A rapidly communications media. This project provi- probability of intercept techniques; lightwe processors and devices, advanced network enabling communication signal processing	es will provide deployed force des the technolo eight, phased arr protocols and so techniques.	capabilities for requires assur ogies for: mult ay antennas; ar ervices, intellig	er, mgn capaci en-route and c ed connectivity i-level, secure, ad modular, pro- gent communic	deployed distrib y with reliable, ; , seamless netwo ogrammable, lo ations managen	uted collaborat responsive, affe orks; advanced w-cost softwar nent and contro	ive command ordable inform communication e radios. It in l, advanced co	, control, sur- nation exchar ons processor cludes techno ommunicatio	veillance, nge via all availabl rs; anti-jam and lo ologies for advance ns algorithms, and	e w ed
(U) MAJOR THRUST: Develop assured and survivable information and networking technologies enabling worldwide 11.830 9.669 9.996 (U) In FY 2007: Completed development of capabilities for self-organizing, self-healing, autonomous networking. Developed policy-based network management technologies for real-time network response to changes in INFOCON levels. Developed and tested communications/resource network management schemas and sensor exploitation technologies enabling the dynamic integration of communications and sensor management functions for more effective moving target exploitation and fusion. Developed airborne content-based delivery networking (CBDN), synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and applied to extremely dynamic infrastructure and network/platform mobility dictated by tactical aircraft. 9.669 9.996 (U) In FY 2008: Continue development of policy-based network management technologies for real-time network response to changes in INFOCON levels. Continue development of airborne CBDN, synergistic with the Joint Tactical Radio System Wideband Networking Waveform's Network Service Layer, and apply to extremely dynamic airborne nets. Continue development of airborne network modeling and simulation technology. Initiate design and development of cognitive network working technology that sense operating environment, learns application requirements, and intelligently adapts network protocols. Initiate design and development of network management agents designed to monitor the airborne domain's handling of the flow of information from platform to platform through various interconnected communication nodes and links. Initiate Exhibit R-2a (PE 0602702F) Project 4519 R+1	(U) <u>B. Accomplishments/Planned Program</u>	(\$ in Millions)					<u>F</u> Y	<u> 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
R-1 Line Item No. 16 Project 4519 Page-3 of 27 Exhibit R-2a (PE 0602702F) 247	 (U) In FY 2007: Completed development of or Developed policy-based network manager levels. Developed and tested communicate technologies enabling the dynamic integra effective moving target exploitation and fit synergistic with the Joint Tactical Radio S applied to extremely dynamic infrastructu (U) In FY 2008: Continue development of poresponse to changes in INFOCON levels. Tactical Radio System Wideband Network airborne nets. Continue design and development of cognitive network requirements, and intelligently adapts network security capability to provide policy-based performance, security, configuration, and intelligent network management agents de information from platform to platform three. 	ssance, and expl capabilities for s ment technologi tions/resource n ation of commu- usion. Develop System Widebar re and network/ olicy-based network/ olicy-based network/ continue devel king Waveform opment of airbo vorking technologi work protocols. d, mission-based fault manageme esigned to moni ough various in	oitation operatively obtained to a series of the series of	ions for the Ai , self-healing, a e network resp ement schemas ensor managen ntent-based del Waveform's N lity dictated by ent technologie borne CBDN, s vice Layer, and odeling and sir operating envia and developm n, heterogeneou tric environme e domain's hand ommunication	r Force. autonomous net onse to changes and sensor exp nent functions f livery networkin letwork Service tactical aircraft sofor real-time r synergistic with d apply to extre mulation techno ironment, learns nent of network us network qual ent. Develop an dling of the flow nodes and links	working. in INFOCON loitation for more ng (CBDN), Layer, and t. network the Joint mely dynamic logy. Initiate s application operations and ity of d complete v of 5. Initiate				
	Project 4519			R-1 Line Iten Page-3 c	n No. 16 of 27 7				Exhibit R-2a (F	PE 0602702F)

Exhibit R-2a, R	Exhibit R-2a, RDT&E Project Justification					
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT N 4519 Com	UMBER AND TITLE	≘ echnology		
(U) B. Accomplishments/Planned Program (\$ in Millions) development of a resilient and self-regenerating informatio recognizes, characterizes, and understands novel cyber atta synthetically diverse, functionally equivalent software, and the mission critical enterprise to resist new attacks.	n Network Centric Warfare enterprise that dynamically cks and service anomalies, aids in the creation of continuously monitors, reconfigures, and self optimizes	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) In FY 2009: Complete development of airborne CBDN, sy Networking Waveform's Network Service Layer, and appli and development of airborne network modeling and simula cognitive networking technology that senses operating envi- network protocols. Complete development of policy-based response to changes in INFOCON levels. Continue design capability to provide policy based, mission based, cross do security, configuration, and fault management. Initiate dev protocol compatible, covert network radios. Continue develop Network Centric Warfare enterprise that dynamically recog and service anomalies, aids in the creation of synthetically continuously monitors, reconfigures, and self optimizes the development of secure data sharing to prevent the disclosu	An ergistic with the Joint Tactical Radio System Wideband es to extremely dynamic airborne nets. Continue design attion technology. Continue design and development of ironment, learns application requirements, and adapts a network management technologies for real-time network and development of network operations and security main, heterogeneous network quality of performance, velopment of small hand-held multi-data rate, internet elopment of a resilient and self-regenerating information gnizes, characterizes, and understands novel cyber attacks diverse, functionally equivalent software, and e mission critical enterprise to resist new attacks. Initiate re of sensitive information to untrustworthy users.					
 (U) (U) MAJOR THRUST: Develop improved, higher bandwidth provide secure, adaptive, covert, anti-jam, and assured glol 	communications and signal processing technologies to bal battlespace connectivity to highly mobile aerospace	4.618	4.329	3.704		
 forces, while reducing the equipment footprint. (U) In FY 2007: Completed first phase development of inform of the Global Information Grid in both wireline and wireles environments to preclude information systems attacks. De combined multi-dimensional (space, time, frequency, codin bandwidth information transmission and exploitation capate intelligence, surveillance, and reconnaissance platforms, ar munitions. Tested and demonstrated a multi-mode, multi-f capability to dynamically alter communications methods u the Joint Tactical Radio System or compatible software derively distribution and cryptography technologies to effect ul 	ation assurance technologies that improve the robustness as networks for air, space, ground, and joint/coalition monstrated promising higher performance, adaptively ng, polarization) transmission techniques that enable high bilities amongst airborne command and control, and nd various weapon delivery systems with their smart function, sense-and-adapt air-mobile communications nder fast-changing environment within the framework of fined radios. Developed and tested promising quantum tra-secure communications for wired and wireless					
Project 4519	R-1 Line Item No. 16 Page-4 of 27		Exhibit R-2a	(PE 0602702F)		

	Exhibit R-2a, RDT&E Proj	DATE February 2008			
BUDGE 02 App	T ACTIVITY plied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT N 4519 Com	UMBER AND TITLE IMUNICATIONS T	echnology
(U) <u>I</u>	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) I p c c c v c r a a t t z	In FY 2008: Complete demonstration of adaptively combined multi-dime bolarization) transmission techniques that enable high bandwidth informat capabilities. Complete demonstration of multi-mode, multi-function, sense capability to dynamically alter communications methods under fast-chang of quantum key distribution and cryptography technologies to effect ultra wireless networks. Initiate design and demonstration of assured access ar combines multi-dimensional (space, time, frequency, coding, polarization nulti wavelength, multi path techniques, and spectrum sense and adapt te assured access (anti-jam) covert high capacity spectrum dominance for gl adversary the same. Initiate development of scaleable video compression pandwidth and quality based upon the priority of the required information automated, network and bandwidth management technologies to move, m	ensional (space, time, frequency, coding, tition transmission and exploitation se-and-adapt air-mobile communications ging environment. Continue development -secure communications for wired and nti-jam communications capability that a) transmission techniques, multi-frequency, schniques. Initiate investigation to provide obal networking while denying the a schemes which dynamically trade off h. Initiate the development of advanced, manage, and process information in real-time			
f (U) E u a t t r	or the warfighter. In FY 2009: Complete development of quantum key distribution and cry altra-secure communications for wired and wireless networks. Continue anti jam communications capability that combines multi-dimensional (spa ransmission techniques, multi-frequency, multi-wavelength, multi-path to echniques. Continue the development of advanced, automated, network nove, manage, and process information in real-time for the warfighter.	ptography technologies to effect design and demonstration of assured access ace, time, frequency, coding, polarization) echniques, and spectrum sense and adapt and bandwidth management technologies to			
(U) (U) N s	MAJOR THRUST/CONGRESSIONAL ADD: Develop critical informat seamless integration of aerospace weapon systems' C2, intelligence, surve	ion transmission technologies to permit the eillance, and reconnaissance	2.091	3.494	1.489
(U) I c	in FY 2007: Explored multiple technologies/techniques for tunable, high overall radio frequency component equipment size, weight, and signal los	power radio frequency filtering to reduce sses. Developed, tested, and assessed			
(U) I t: f t	in FY 2008: Complete development, test, and assessment of exploratory ransfer technologies. Continue to explore multiple technologies/techniquiltering to reduce overall radio frequency component equipment size, we battlefield network operations. Conduct the Congressionally-directed Co	radio frequency and optical information ues for tunable, high power radio frequency ight, and signal losses applicable to mpact Laser Terminal for Airborne			
Projec	t 4519	R-1 Line Item No. 16 Page-5 of 27		Exhibit R-2a	(PE 0602702F)

	Exhibit R-2a, RDT&E Project Just		DATE February 2008		
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJEC 4519 C	T NUMBER AND TITLE	echnology
(U)	B. Accomplishments/Planned Program (\$ in Millions) Network Centric Warfare to develop a compact, low power consumption wavelengt free-space optical communications in an airborne network.	h tunable laser transmitter for	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Complete exploring multiple technologies/techniques for tunable, high to reduce overall radio frequency component equipment size, weight, and signal loss network operations.	h power radio frequency filtering ses applicable to battlefield			
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop cyber operations technolog command, control, communications and intelligence. Note: Increase in funding in emphasis on offensive cyber operations. Note: This effort includes Congressional A FY 2008.	gies for enabling worldwide FY 2008 and FY 2009 is due to Add funding of \$1.9 million in	7.741	13.654	15.492
(U)	In FY 2007: Completed development of intrusion detection techniques for wireless capabilities for damage assessment and recovery. Developed techniques for definin counter adversary information warfare attacks. Developed defensive techniques for systems. Developed detection and eradication techniques for malicious code. Deve computer network attack technologies. Developed advanced correlation fusion techniques is solved.	networks. Developed automated g defensive courses-of-action to wireless, mobile, and embedded loped active response and niques for defensive course of			
(U)	In FY 2008: Complete development of techniques for defining rapid defensive counadversary information warfare attacks. Continue to develop defensive techniques for systems. Demonstrate detection and eradication techniques for malicious code. Concorrelation fusion techniques for defensive course of action analysis. Complete effort Initiate assured end-to-end Quality of Service (QoS) and Quality of Assurance (QoA system enterprise during malicious and non-malicious faults. Develop a prototype to unique aspects of an IP-based airborne network (e.g., aircraft communications, anter components) against a variety of cyber threats with the end-goal of improving the ornetwork. Initiate development of access techniques allowing "cyber paths" to protect systems through a multiplicity of attack vectors. Initiate development of stealth and enabling continued operation within the adversary information network. Initiate protect agathering to achieve cyber awareness and understanding. Initiate technology progradestroy, disrupt, and deceive) effects to the adversary information systems enabling cyber and traditional kinetic operations. Conduct Congressionally-directed Cyber Actional States and traditional kinetic operations.	rses-of-action (COA) to counter or wireless, mobile and embedded mplete development of advanced orts in self-healing systems. A) integration to the information hat will be able to model the nnas, and networking verall defenses of the airborne cted adversary information l persistence technologies grams to provide the capability to enabling cyber intelligence to deliver D5 (deny, degrade, integrated and synchronized Attack Mitigation Lab effort to			
Proi	ect 4519 R-1 Line Page	Item No. 16 -6 of 27		Exhibit R-2a	(PE 0602702F)
	2	50			

	Exhibit R-2a, RDT&E Project Justification								February	2008
BUDGET ACTIVITY 02 Applied Research				PE NUMBER A 0602702F C Communica	ND TITLE command Cont ations	trol and	PROJECT NUMBER AND TITLE 4519 Communications Technology			
(U)	B. Accomplishments/Planned Progra develop malware detection and reverse	um (\$ in Mil	lions) in order to prov	vide a significan	t increase in und	lerstanding of	H	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
	malware, as well as protection to the G	lobal Inform	ation Grid and o	other critical infi	rastructures	orstanding of				
(U)	In FY 2009: Initiate work in Cyber Co	mmand and	Control for defe	ensive cyber ope	rations to achiev	ve cyber				
	awareness and understanding. Continu	e to develop	defensive techr	iques for wirele	ess, mobile, and	embedded				
	systems. Continue assured end-to-end	Quality of S	ervice (QoS) an	d Quality of Ass	surance (QoA) is	ntegration to the				
	response to rapidly recover from adver	ancious and sarv cyber at	tacks Continue	development of	Finformation system	stem access				
	methods. Initiate efforts to propagate t	hrough adve	rsary networks.	Continue devel	opment of steal	th and persistence	e			
	technologies enabling network discove	ry, propagati	ion to new locat	ions, and data ex	xfiltration/infiltr	ation. Continue				
	cyber intelligence gathering efforts to a	chieve cybe	r situational awa	areness and unde	erstanding. Con	tinue cyber and				
	traditional kinetic weapon integration t	echnology de	evelopment and	initiate efforts f	or cyber deliver	y to influence				
an	operations effects.									
(U)	CONGRESSIONAL ADD: Adaptive	Optics Laser	com System.					2.454	1.600	0.000
(U)	In FY2007: Developed and demonstra	ted reliable b	oi-directional gr	ound and/or airb	orne lasercom c	ommunications				
	link that automatically acquires and ma	intains itself	in a seamless o	peration.						
(U)	In FY2008: Continue the integration o	f the laser co	ommunications t	erminal into a V	Vescam turret ar	id support an air				
	to ground flight test scheduled for mid-	2008. The f	light test will va	d the performen	beam pointing, a	acquisition, and				
	airborne environment	iniai operatio	ni at attitude, an	u ule performan	ce of the adaptive	ve opties in an				
(U)	In FY2009: Not Applicable.									
(U)										
(U)	Total Cost							28.734	32.746	30.681
(U)	C. Other Program Funding Summary	<u>y (\$ in Millio</u>	<u>ons)</u>							
]	FY 2007	<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>Estimate</u>	<u>Complete</u>	<u>10tar C03t</u>
(U)	Related Activities:									
(0)	Development									
(U)	This project has been									
Ì Í	coordinated through the									
				R-1 Line	Item No. 16					
Pro	ect 4519			Page	e-7 of 27				Exhibit R-2a (PE 0602702F)

Exhibit R-2a, RDT&E	DATE February 2008	
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4519 Communications Technology
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Reliance 21 process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. 	Communications	
Project 4519	R-1 Line Item No. 16 Page-8 of 27 252	Exhibit R-2a (PE 0602702F)

E	xhibit R-2a, I	RDT&E Pro	oject Justifi	ication			DATE	February	2008
BUDGET ACTIVITY 02 Applied Research			P 0 0	E NUMBER AND 602702F Con Communicatio	TITLE nmand Contr ons	ol and	PROJECT NUMBER AND TITLE 4594 Information Technology		
Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4594 Information Technology	32.946	31.946	32.564	29.136	30.994	37.404	39.557	Continuing	TBD
Quantity of RD1&E Articles	0	0	0	0	0	0	0		
accurate information. This project impro- timeliness and precision needed to accor agencies, and open source information. enterprise. Knowledge, information, and required to achieve this capability are de project develops high-payoff embedded information dominance and air and space information systems to the warfighter.	accurate information. This project improves global awareness at all levels, enabling warfighters to understand relevant military situations on a consistent basis with the timeliness and precision needed to accomplish their missions. Global awareness is achieved by exploiting information provided by the Air Force, other government agencies, and open source information. The information is fused to support the dynamic planning, assessment, and execution cycles via the global information enterprise. Knowledge, information, and data are all archived in the global information base for continued use and historical analysis. The information technologies required to achieve this capability are developed under this project in an affordable manner and include appropriate access mechanisms for our coalition partners. This project develops high-payoff embedded information systems technologies for the next generation of distributed information architectures to enable global information dominance and air and space superiority. The embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative, secure, net-enabled embedded information systems technologies provide affordable, innovative,								
 (U) B. Accomplishments/Planned Progra (U) MAJOR THRUST: Develop innovativ space environment. (U) In FY 2007: Evaluated fusion manager Developed the process of probabilistic confidence through the inclusion of hig refinement area. Developed techniques changing threat conditions. Developed optimize the fusion process for identified network centric approaches to provide of (U) In FY 2008: Evaluate fusion managem Continue the process of probabilistic id probabilistic confidence through the inc process refinement area. Continue to d to adapt to changing threat conditions. management techniques that optimize t significant threats. Evaluate network centered 	m (\$ in Millions) e multi-sensor col nent and advance dentification thro her-level fusion to to dynamically u intelligence, surv cation and continu listributed fusion ent and advance t entification throug lusion of higher-levelop techniques Continue to devel ne fusion process entric approaches	laborative fusi d the state-of-th ugh the use of echniques in th pdate advanced eillance, and re ous tracking of techniques to the state-of-the- gh the use of m evel fusion tect to dynamicall op intelligence for identification to provide dist	on technologies he-art in track-t multi-source fu e situational ass d reasoning fus econnaissance r f military signif the warfighter. -art in track-to-to- nulti-source fusi- shniques in the s y update advan- e, surveillance, on and continue ributed fusion t	s in a fully distr to-track fusion to ision. Increased sessment and prion engines to a management tech ficant threats. The track fusion tech ion. Continue to situational assest ced reasoning for and reconnaissa ous tracking of techniques to th	ibuted air and echniques. d probabilistic cocess udapt to chniques that Evaluated hniques. o increase ssment and usion engines ance military e warfighter.	ΕΥ	<u>7.501</u>	<u>FY 2008</u> 7.016	<u>FY 2009</u> 6.856
Develop new track algorithms that com Project 4594	bine traditional ki	nematic associ	R-1 Line Iten Page-9 c 253	Iti-INT (multip n No. 16 of 27 3	le types of			Exhibit R-2a (F	PE 0602702F)

	Exhibit R-2a, RDT&E Project Ju	DATE February 2008				
BUD(02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT N 4594 Info	CT NUMBER AND TITLE		
(U)	B. Accomplishments/Planned Program (\$ in Millions) intelligence) reasoning to improve the identification and track life times of ground account the limitations of gap times, dense target environments and large sensor of algorithms that can automatically develop, reason, and dynamically update various intelligence preparation of the battlespace products (e.g., named areas, target areas lines of communication). Initiate development of fused air, ground, and space im- machine-to-machine automatic fusion and dynamic re-tasking processes resulting operational picture. Processes to be examined include machine-to-machine autor automated tracking and ID of nominated targets, and automated/adaptive pattern of Fusion of CybINT (Cyber Intelligence) with traditional INTs.	d moving targets; taking into data inaccuracies. Develop a set of us sub-sets of the existing as, COA, units, infrastructure areas, formation through g in a single network centric nated multi-INT fusion, long-term recognition. Initiate investigation	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Evaluate fusion management and advance the state-of-the-art in trace Complete the process of probabilistic identification through the use of multi-sour- probabilistic confidence through the inclusion of higher-level fusion techniques in process refinement area. Complete the development of techniques to dynamically engines to adapt to changing threat conditions. Complete the development and as surveillance, and reconnaissance management techniques that optimize the fusior continuous tracking of military significant threats. Complete the development an approaches to provide distributed fusion techniques to the warfighter. Continue t algorithms that combine traditional kinematic associations with multi-INT reason and track life times of ground moving targets; taking into account the limitations environments and large sensor data inaccuracies. Complete the development of a automatically develop, reason, and dynamically update various sub-sets of the ex- battlespace products (e.g., named areas, target areas, COA, units, infrastructure a Continue development of fused air, ground, and space information through mach and dynamic re-tasking processes resulting in a single network centric operationa include machine-to-machine automated multi-INT fusion, long-term automated t and automated/adaptive pattern recognition. Continue investigation of Fusion of	ck-to-track fusion techniques. ce fusion. Continue to increase in the situational assessment and y update advanced reasoning fusion ssessment of intelligence, in process for identification and id assessment of network centric the development of new track asing to improve the identification of gap times, dense target a set of algorithms that can isting intelligence preparation of the reas, lines of communication). ine-to-machine automatic fusion al picture. Processes to be examined racking and ID of nominated targets, CybINT with traditional INTs.				
(U) (U)	MAJOR THRUST: Develop higher-level fusion and the enabling information/kn achieve situational awareness and understanding at all command levels for the dy execution processes.	nowledge base technologies to ynamic planning, assessment, and	6.618	7.272	9.145	
(U) Pro	In FY 2007: Enhanced techniques for interactive contextual reasoning with infer R-1 Li R-1 Li Pa	ence techniques for self-organizing ne Item No. 16 ge-10 of 27 254		Exhibit R-2a	(PE 0602702F)	

Exhibit R-2a, RDT&E Pro	DATE February 2008			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT I 4594 Info	NUMBER AND TITLE	logy
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> data repositories and content-based extraction to support identification of web-based search techniques, data filtering techniques, and information the explosion of available open source data on the Web required for rapi- inferencing techniques for reasoning about the situation and for predicti	of potential events in the world. Enhanced aggregation methods to take advantage of id situational understanding. Developed ng enemy intent and threat possibility.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) In FY 2008: Complete enhancement of techniques for interactive contexself-organizing data repositories and content-based extraction to support world. Continue enhancement of web-based search techniques, data filt aggregation methods to take advantage of the explosion of available opersituational awareness and understanding. Continue developing inference situation and for predicting adversarial intent and threat possibility. Deversariagement capability with the objective of increasing the execution specomputers and enterprise infospheres by 100X. Initiate development of techniques to support analysis of current situations. Initiate development of techniques to support analysis of current situations. Initiate development of techniques, surveillance, and reconniassance (ISR) defense on wired net multiple, coordinated, sustained attacks. Initiate research to forecast act ability to appraise and plan the "best" blue course of action for Rapid, D achieve the capability to analyze multiple COA having cascading effects able to mix kinetic and non-kinetic options, continuously forecast the di play COAs forward in time to identify key plan dependencies, decision (U) In FY 2009: Complete enhancement of web-based search techniques, d 	xtual reasoning with inference techniques for t identification of potential events in the ering techniques, and information en source data on the Web required for rapid ing techniques for reasoning about the velop a dynamic real-time information beeds of embedded high performance multi-source and automated recognition at of technology demonstration plans for of cooperative agents under positive control mology demonstration plans for active etworks to perform an adaptive response to ionable futures to support a decision maker's becide, Act, and Adapt. Initiate research to s in near real-time. The capability will be rect and indirect effects of each COA, and points, and the foreclosure of options. ata filtering techniques, and information			
(c) In TT2007. Complete enhancement of web based search techniques, a aggregation methods to take advantage of the explosion of available ope situational awareness and understanding. Continue developing inferenc situation and for predicting enemy intent and threat possibility. Continu automated recognition techniques to support analysis of current situation demonstration plans for cyber situational awareness and understanding to agents under positive control to defend mission critical Air Force assets. demonstration plans for active ISR defense on wired networks to perform coordinated, and sustained attacks. Continue research to achieve the cap (COA) having cascading effects in near real-time. The capability will be	en source data on the Web required for rapid ing techniques for reasoning about the the development of multi-source and ns. Continue development of technology using an autonomous set of cooperative . Initiate development of technology m an adaptive response to multiple, pability to analyze multiple courses of action the able to mix kinetic and non-kinetic options,			
Project 4594	R-1 Line Item No. 16 Page-11 of 27		Exhibit R-2a	(PE 0602702F)

	Exhibit R-2a, RDT&E Project Just	DATE February 2008			
BUD(02 A	JET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJEC 4594 In	T NUMBER AND TITLE formation Techno	logy
(U)	B. Accomplishments/Planned Program (\$ in Millions) continuously forecast the direct and indirect effects of each COA, and play COAs fo plan dependencies, decision points, and the foreclosure of options. Continue researce to support a decision maker's ability to appraise and plan the "best" blue course of ac Adapt. Complete the development of a set of algorithms that can automatically develop various sub-sets of the existing intelligence preparation of the battlespace products (COA, units, infrastructure areas, lines of communication).	rward in time to identify key th to forecast actionable futures ction for Rapid, Decide, Act, and elop, reason, dynamically update e.g., named areas, target areas,	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	MAJOR THRUST: Develop automatic and dynamically reconfigurable, affordable, processing technologies for real-time C2 global information systems. In FY 2007: Completed evaluation of architectural features for cognitive informatio algorithms for next generation information technologies for C2 systems. Developed information processing. Developed and characterized high performance computers applications. Initiated development and characterization of the next generation of hi In FY 2008: Initiate implementation of architectural features for cognitive informati algorithm development for next generation information technologies for C2 systems characterization of high performance computers for quantum computing applications characterization of the next generation of high performance computers. Develop a p hybrid architecture design, which will provide an emulation capability for large-scal evaluations. Initiate the development of the tools, techniques, standards, and techno complex software-intensive systems. In FY 2009: Continue implementation processing. Complete development and characterized for quantum computing applications. Continue development for cognitive information processing. Complete development and characteric of high performance computers. Complete the development of a prototype chip that design, which will provide an emulation capability for large-scale cognitive architect development of the tools, techniques, standards, and technologies for C2 systems development of the tools, techniques, standards, and technologies for C2 systems development for cognitive information processing. Complete development and characteric of high performance computers. Complete the development of a prototype chip that design, which will provide an emulation capability for large-scale cognitive architect development of the tools, techniques, standards, and technologies required to build f software-intensive systems. Initiate development of high capacity processing on derincreasing amounts of raw data to actionable information	scalable, distributed petaflop on processing. Developed architecture for cognitive for quantum computing gh performance computers. ion processing. Continue . Continue development and s. Continue development and orototype chip that contains a e cognitive architecture logies required to build highly ation processing. Complete . Complete architectural acterization of high performance erization of the next generation contains a hybrid architecture ture evaluations. Continue the highly complex mand, which will reduce the ever stem/support software that	4.680	6.232	7.035
	R-1 Line I	tem No. 16		_	/
Proj	ect 4594 Page-	12 of 27		Exhibit R-2a	(PE 0602702F)

	Exhibit R-2a, RDT&E Project Jus	tification	DATE February 2008			
BUDC 02 A	BET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT N 4594 Info	NUMBER AND TITLE rmation Techno	TITLE chnology	
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) MAJOR THRUST: Develop modeling and simulation technologies for the next ger and execution environments	neration of planning, assessment,	<u>FY 2007</u> 2.724	<u>FY 2008</u> 2.775	<u>FY 2009</u> 2.269	
(U)	In FY 2007: Demonstrated advanced modeling and simulation technologies to supprexecution and assessment environments. Demonstrated adversarial behavior model course of action assessment and prediction. Conducted concept demonstrations of i assessment of friendly versus enemy courses of action. Demonstrated a prototypical and prediction system. Investigated advanced concepts to provide approaches for a warfighter to build composable simulations.	bort next generation planning s and modeling techniques for ntegrated interaction and l dynamic situation assessment modeling toolset that enables the				
(U)	In FY 2008: Complete demonstrations of advanced modeling and simulation techno generation planning, assessment, and execution environments. Continue to demons and modeling techniques for COA assessment and prediction. Continue to conduct integrated interaction and assessment of friendly versus adversary courses of action prototypical dynamic situation assessment and prediction system. Continue to invest provide approaches for a modeling toolset that enables the warfighter to build comp investigation of ability to forecast potential adversaries and events based on indicati projected known and/or anticipated threat(s).	blogies to support next trate adversarial behavior models concept demonstrations of . Continue to demonstrate a stigate advanced concepts to osable simulations. Initiate ons of known evidence and				
(U)	In FY 2009: Complete demonstrations of adversarial behavior models and modelin assessment and prediction. Continue to conduct concept demonstrations of integrat friendly versus adversary courses of action. Complete demonstration of a prototypi and prediction system. Continue to investigate advanced concepts to provide appro enables the warfighter to build composable simulations. Continue investigation of a adversaries and events based on indications of known evidence and projected known	g techniques for courses of action ed interaction and assessment of cal dynamic situation assessment aches for a modeling toolset that ability to forecast potential n and/or anticipated threat(s).				
(U)		-				
(U)	MAJOR THRUST: Develop real-time embedded information system technologies embedded systems to enable affordable design and development of state-of-the-art h innovatively incorporate new capabilities, reactively adapt to multiple missions and validate, and assure functionality and integrity, and facilitate rapid insertion to supp operations within a net-centric enterprise.	for complex, time-critical, nardware and software, changing environments, verify, ort real-time, collaborative	2.168	2.683	1.954	
(U)	In FY 2007: Developed dynamically reconfigurable aerospace systems using adapt support image/video processing and data compression. Completed program to deve computing technologies to support enhanced interoperability and information excha	ive computing techniques to lop adaptive embedded nge between tactical C2				
Proi	ect 4594 R-1 Line	Item No. 16 13 of 27		Exhibit R-2a	(PE 0602702F)	
0	200, 100	257			00027021)	

	Exhibit R-2a, RDT&E Project J	DATE February 2008			
BUDG 02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT N 4594 Info	IUMBER AND TITLE	E Dlogy
(U)	B. Accomplishments/Planned Program (\$ in Millions) platforms to support network centric operations, based on Real-Time Java and reprocesses, methods, and techniques to provide assured performance, integrity, ar information systems. Developed algorithms, methods, and processes to support management of system resources across multiple tactical platforms. Developed real-time embedded system architectures. Developed methods of computation a biologically-inspired and biologically-based computation for embedded systems power-aware, polymorphic aerospace systems for mission-aware computing.	econfigurable computing. Developed ad security of real-time embedded real-time, adaptive resource multi-level secure middleware for ad computing processes using application. Developed	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	In FY 2008: Continue development of dynamically reconfigurable aerospace sy techniques to support image/video processing and data compression. Continue dassurance architecture components for real-time embedded systems supporting N Levels of Security (MLS/MSLS) and mixed criticality. Continue development of computing processes using biologically-inspired and biologically-based computa application. Initiate development of power-aware, polymorphic aerospace system. In FY 2009: Complete development of dynamically reconfigurable aerospace systems.	stems using adaptive computing levelopment of affordable, high Aulti-Level Security/Multiple Single of methods of computation and ation for embedded systems ms for mission-aware computing. Aystems using adaptive computing			
	techniques to support image/video processing and data compression. Complete a assurance components for real-time embedded systems supporting MLS/MSLS a development of methods of computation and computing processes using biologic computation for embedded systems application. Complete development of power systems for mission-aware computing.	development of affordable, high and mixed criticality. Complete cally-inspired and biologically-based er-aware, polymorphic aerospace			
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop digital information exp communications and special signals intelligence, imagery, and measurement sign correlation, and timeliness of the information value to the decision maker. Note Add funding of \$1.5 million in FY 2007.	loitation technologies for electronic natures to increase accuracy, : This effort includes Congressional	9.255	5.968	5.305
(U) (U)	In FY 2007: Completed first phase development of techniques in steganography digital data forensics for imagery, video, and speech information protection and exploitation. Developed the multi-intelligence toolsets for the processing, explo actionable intelligence, including the development of measurement and signature which integrates inputs from various sensors and visually display the critical MA Congressionally-directed effort for MASINT visualization tools.	y, steganalysis, watermarking, and authentication, and intelligence itation, and dissemination of es intelligence (MASINT) capability ASINT information. Conducted			
Proj	ect 4594	ine Item No. 16 age-14 of 27		Exhibit R-2a	(PE 0602702F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD(02 A	GET ACTIVITY Applied Research				PE NUMBER A 0602702F C Communica	ND TITLE Command Cont ations	trol and	PROJECT NUM	ABER AND TITLE	logy
(U)	B. Accomplishments/Planned Pr dissemination of actionable intellig enhance detection (by 50%), ident targets; taking into account the con from multiple MASINT sensors. I channelization effects in modern r analysts the capability to automati	ogram (\$ in Mil gence. Develop ification (by 25% mplementary sign Develop algorith nodulated person cally detect spee	llions) more effective r b), and assessme nature features (ms to automatic hal communicati ch privacy and i	nulti-sensor sign ent (10X reduction e.g., geo-physication ally detect and its ons systems (PC dentify methods	ature exploitation on in analyst time al, materials) that dentify audio pro- S) with the goal and means used	on algorithms to te) of difficult at can be derived otection and of providing l.	J	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	actionable intelligence. Complete to enhance detection (by 50%), ide targets; taking into account the con from multiple MASINT sensors. C and channelization effects in mode analysts the capability to automati development of methods and meel code/data and detection and eradic prevention of embedded malicious development of self-correcting wa	the development entification (by 2 mplementary sign Complete the development cally detect speed nanisms to achieve eation systems for a software (malw termarked code a	t of more effecti 5%), and assess nature features (velopment to autorsonal commun ch privacy and i ve robust/tamper r polymorphic n are), system self and data for trus	we multi-sensor ment (10X reduc e.g., geo-physica tomatically detect ications systems dentify methods r-proof self-authonalware. Resear f-optimization/di ted and optimize	signature exploi ction in analyst (al, materials) tha ct and identify and with the goal of and means used enticating, self-i ch will include to iagnosis/recover ed computing.	tation algorithms time) of difficult at can be derived udio protection f providing l. Initiate regenerating the detection and ty, and the	3			
(U)	Total Cost							32.946	31.946	32.564
(U)	C. Other Program Funding Sum	mary (\$ in Milli <u>FY 2007</u> Actual	<u>ons</u>) <u>FY 2008</u> 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>
(U) (U) (U)	Related Activities: PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.									
Pro	ject 4594			R-1 Line Page	e Item No. 16 -15 of 27				Exhibit R-2a ((PE 0602702F)
				4						

Exhibit R-	Exhibit R-2a, RDT&E Project Justification			
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NUMBER AND TITLE 4594 Information Technology		
(U) <u>D. Acquisition Strategy</u> Not Applicable.				
Project 4594	R-1 Line Item No. 16 Page-16 of 27	Exhibit R-2a (PE 0602702F)		
		,,		

	Ex	hibit R-2a, F	RDT&E Pro	oject Justif	ication			DATE	February	2008	
BUD(02 A	GET ACTIVITY Applied Research			P 0 0	PE NUMBER AND 602702F Con Communicatio	TITLE nmand Contr ons	ol and	PROJECT NUME 5581 Comma Technology	OJECT NUMBER AND TITLE 81 Command and Control (C2) chnology		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
558	Technology	48.236	39.620	36.256	46.508	44.126	43.062	41.917	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
	real-time, distributed battle management a new structured and ad hoc processes in res information interoperability, while reducin techniques knowledge bases, distributed in technologies will vastly improve the milita track objects and events will improve the a to counter their intentions. Advances in the the Expeditionary Aerospace Force. Adva varying crisis levels, as required, by a Net- delivery of high-quality, timely, secure info	nd control. Tec sponse to rapidly ng the cost of C2 nformation syste ary decision male awareness and u ne development unces in distribut -Centric Aerosp formation to the	hnologies in the changing war systems and i ems, and inform king process war nderstanding a of very large co ted intelligent is ace Force. Ad warfighter.	is project must fare challenges nfrastructure. 7 nation manager ithin C2 system nd prediction o omprehensive k information sys vances in robus	be capable of t Technology dev nent and distribus. Advances in of adversarial in knowledge base stems will allow st information n	aking advantag being develop velopment in th oution services. In the ability to a tentions, allow as to rapidly for v automatic rap management an	e of future net ed will increas is project focu Advances in rapidly detect, ing the develop mulate and creat id reconfigurate d disseminatio	te-centric environ se capability, quases on planning planning and as classify, identif pment of variou eate new knowled tion of C2 center on technologies	aments includir ality, and and assessing sessment by, and continue s courses of ac edge are needed ars to respond to will ensure the	ng ously tion d by o	
(U)	B. Accomplishments/Planned Program	<u>ı (\$ in Millions)</u>					<u>F</u> Y	<u> 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	MAJOR THRUST: Investigate and deve	lop technologie	s for the rapid	development ar	nd application of	of next		7.503	6.456	4.892	
(U) (U)	generation knowledge bases for aerospac In FY 2007: Completed development of knowledge bases for aerospace C2 system practical automated reasoning of the scale real-world requiring intelligence. Investi learning agents that can generate well-foo classification of link patterns for discover In FY 2008: Continue to develop foundar reasoning of the scale and complexity rec	e C2 systems. technologies for ns. Developed f e and complexit gated and develocuted and develocuted cuted knowledgering relevant line ations, technolog quired for complete	r the rapid deve foundations, tec y required for o oped specialize e bases for auto kages between sy, and tools to uters to perform	elopment and a chnology, and t computers to pe ed cognitive arc omated intellige entities. enable effectiv n complex task	pplication of ne cools to enable e erform complex chitectures using ent extraction, co re, practical auto s in the real-wo	ext generation effective, a tasks in the g self-aware, correlation, and omated rld requiring					
	intelligence. Continue to investigate and agents that can generate well-focused kno classification of link patterns for discover the capability, given commander's policie	develop special owledge bases for ring relevant lind es and Rules of I	ized cognitive or automated in kages between Engagement, to	architectures un ntelligent extract entities. Devel papply context	sing self-aware ction, correlatio lop a prototype -aware access c	, learning n, and that will have ontrol to					
Pro	ject 5581			R-1 Line Iter Page-17	n No. 16 of 27				Exhibit R-2a ((PE 0602702F)	
				261						· · · · · · · · · · · · · · · · · · ·	

	Exhibit R-2a, RDT&E Project Jus	DATE February 2008			
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT 5581 Co Technol	NUMBER AND TITLE mmand and Cont ogy	trol (C2)
(U)	B. Accomplishments/Planned Program (\$ in Millions) rapidly detect significant events and initiate reprioritization as required using operation management infrastructure. Initiate development of automated capture knowledge in globally distributed respositories.	ional databases and an available and self-organization of	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue to develop foundations, technology, and tools to enable effect reasoning of the scale and complexity required for computers to perform complex ta intelligence. Continue to investigate and develop specialized cognitive architecture agents that can generate well-focused knowledge bases for automated intelligent exclassification of link patterns for discovering relevant linkages between entities.	ctive, practical automated asks in the real-world requiring s using self-aware, learning traction, correlation, and			
(U)					
(U)	MAJOR THRUST: Investigate, analyze, and develop technologies for automatic ra intelligent information systems to varying crisis levels faced by the Expeditionary A	pid reconfiguration of distributed Aerospace Force.	13.222	10.174	9.939
(U)	In FY 2007: Developed dynamic and adaptable interface technology that allows co mission-tailored view of the configuration and status of the currently executing Air process. Developed advanced interactive displays suitable for rapid deployment in applications and command centers. Developed advanced techniques and AOC-base visualization for use in conjunction with multiple, heterogeneous data sets. Develop fidelity, accuracy, and interconnection of computer-based wargames used to prepare strategies. Developed technologies for a holistic tool set that commanders can use to reason, and predict activities in the battlespace.	mmanders to create a Operations Center (AOC) C2 harsh environments with C2 ed applications for information ped technologies to improve the e contingency plans and response to probe, study, analyze, visualize,			
(U)	In FY 2008: Complete the development of dynamic and adaptable interface technolocreate a mission-tailored view of the configuration and status of the currently executed to develop advanced interactive displays suitable for rapid deployment in harsh environment of advanced techniques and AOC-based techniques and AOC-base	logy that allows commanders to ting AOC C2 process. Continue ironments with C2 applications used applications for information			
	visualization for use in conjunction with multiple, heterogeneous data sets. Continu improve the fidelity, accuracy, and interconnection of computer-based wargames us and response strategies. Continue development of technologies for a holistic tool se probe, study, analyze, visualize, reason, and predict activities in and around the batt mission planning process that will provide a self-healing, secure, rule-based automa	tic scheduling process that			
	resembles an auction style planning capability. Initiate development of capabilities centric enabled environment. Develop timely option generation selection and coord for uncertainty and missing and erroneous information, and supports intuitive decisions and supports intuitive decisions.	to be more agile within a net lination capabilities that account			
	for uncertainty and missing and enoncous mormation, and supports multive decisi	ion making process between mail			
Proi	R-1 Line Page	Item No. 16 -18 of 27		Exhibit R-2a	(PE 0602702F)
	2	262			

Exhibit R-2a, RDT&E Project Justification	DATE February 2008			
BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602702F Command Control and Communications	PROJECT N 5581 Com Technolo	UMBER AND TITLE mand and Con gy	trol (C2)	
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> and machine collaborating on complex, dynamic problems exploiting the respective strengths of machines (process lots of data) and human (analytical reasoning). Develop dynamic workflow and workload management capabilities to manage the command and control constellation of resources.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) In FY 2009: Continue to develop advanced interactive displays suitable for rapid deployment in harsh environments with C2 applications and command centers. Continue development of advanced techniques and AOC-based applications for information visualization for use in conjunction with multiple, heterogeneous data sets. Continue to develop technologies to improve the fidelity, accuracy, and interconnection of computer-based wargames used to prepare contingency plans and response strategies. Continue development of technologies for a holistic tool set that commanders can use to probe, study, analyze, visualize, reason, and predict activities in the battlespace. Continue development of capabilities to be more agile within a net centric enabled environment. Continue the development of timely option generation selection and coordination capabilities that account for uncertainty and missing and erroneous information, and supports intuitive decision making process between man and machine collaborating on complex, dynamic problems exploiting the respective strengths of machines (process lots of data) and human (analytical reasoning). Continue the development of dynamic workflow and workload management capabilities to manage the command and control constellation of resources.				
 (U) (U) MAJOR THRUST: Investigate and develop technologies to securely share information via publish, subscribe, and query with coalition partners as part of the overall Global Information Grid approach. Sharing of information is in part a function of secure sharing, but is also a function of the managing of the information in assessing the 	9.074	7.707	6.649	
 trustworthiness of the information and its markup. (U) In FY 2007: Completed development of techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Completed development of technology approaches to rapidly assimilate appropriate coalition partners into appropriate community of interest (COI) Infospheres. Completed investigation on performing and enforcing role-based access control to these COI Infospheres. Conducted cross-domain information sharing research and development to include collaborative monitoring and management of multi-national enterprise resources. Developed techniques and tools that will ensure availability, integrity, and survivability of information within a coalition net-centric environment. Investigated technologies, which can determine the pedigree of information in a coalition. Investigated and prototyped the application of information fusion and information management technologies such as fuselets to extend composite views of events across a multi-domain enterprise into fused events. Developed publish/subscribe technologies for application to a 				

	Exhibit R-2a, RDT&E Project Jus	DATE February 2008				
BUD(02 A	GET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT N 5581 Com Technolo	CT NUMBER AND TITLE Command and Control (C2) nology		
(U)	B. Accomplishments/Planned Program (\$ in Millions)	nent of user information	FY 2007	FY 2008	<u>FY 2009</u>	
(U)	In FY 2008: Continue cross-domain information sharing research and development monitoring and management of multi-national enterprise resources. Continue devel that will ensure availability, integrity, and survivability of information within a coal Continue to investigate and prototype the application of information fusion and info technologies such as fuselets to extend composite views of events across a multi-do Continue development of publish/subscribe/query technologies for application to a network management of user information. Initiate development of technologies to information sources across COIs.	to include collaborative lopment of techniques and tools ition net-centric environment. ormation management main enterprise into fused events. CBDN system for intelligent systematically integrate				
(U)	In FY 2009: Complete cross-domain information sharing research and development monitoring and management of multi-national enterprise resources. Continue development that will ensure availability, integrity, and survivability of information within a coal Continue to investigate technologies, which can determine the pedigree of informat and assess the trustworthiness of the marked up information to be shared throughout investigate and prototype the application of information fusion and information man fuselets to extend composite views of events across a multi-domain enterprise into the development of publish/subscribe/query technologies for application to a CBDN sy management of user information.	t to include collaborative lopment of techniques and tools ition net-centric environment. ion in a coalition environment t the coalition. Continue to nagement technologies such as fused events. Continue stem for intelligent network				
(U) (U)	MAJOR THRUST: Develop next generation monitoring, planning, execution, and	assessment technologies and	9.618	7.872	6.739	
(U)	tools enabling distributed aerospace commanders to efficiently and collaboratively of In FY 2007: Completed development of next generation of monitoring, planning, et technologies and tools enabling aerospace commanders to efficiently and collaborate campaigns. Completed development of technologies to dynamically and rapidly as near-real-time command of manned and unmanned forces to execute the required m incorporation of decision support science into C2 tools. Completed course of action collaboration between geographically remote locations. Investigated application of advanced decision-making concepts to C2 activities within a Coalition AOC. Deve systems capable of supporting joint/coalition C2 for various missions in a dynamica Developed tools to increase situational awareness through intelligent information pr systems and federation of systems engineering in the creation of joint C2 capabilitie	develop effects-based campaigns. xecution, and assessment tively develop effects-based sess the battlespace and provide tissions. Completed the analysis capability to allow decision support sciences and loped intelligent information the sessing. Applied system of the session of the application of				
Pro	ject 5581 R-1 Line Page	Item No. 16 ·20 of 27		Exhibit R-2a	(PE 0602702F)	
		264				

	Exhibit R-2a, RDT&E Project Justific	cation	DATE February 2008			
BUD(02 A	JET ACTIVITY PE Ipplied Research 06 C C	ENUMBER AND TITLE	PROJECT N 5581 Con Technolo	NUMBER AND TITLE mmand and Control (C2) logy		
(U)	B. Accomplishments/Planned Program (\$ in Millions) intelligent software agents as virtual battle staff members to enhance various C2 process demonstrated an effects-based dynamic tasking process enabled by dynamically accessi services	ses. Developed and ble data and information	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Continue to investigate application of decision support sciences and advant concepts to C2 activities within a Coalition AOC. Continue to develop intelligent information supporting joint/coalition C2 for various missions in a dynamically changing environment tools to increase situational awareness and understanding through intelligent information application of system-of-systems and federation-of-systems engineering in the creation. Continue to explore the application of intelligent software agents as virtual battle staff in C2 processes. Complete the development and demonstration of an effects-based dynamically accessible data and information services. Initiate development of capabilit for effects attainment at all levels of a campaign, linking leading indicators to desired and capability will utilize causal reasoning, linking effects to actions to desired end-state, we non-linear causal linkages, and will be capable of reasoning through uncertainty and am achieve the ability to predict the current and future impact of an adversary cyber attack systems. Develop effects-based defense models to help predict the 1st and 2nd order in information system/mission. Develop Cyber defense containment scenarios that minim adversary impact to net-centric warfare (NCW) mission.	aced decision-making mation systems capable of ent. Continue to develop n processing. Continue the of joint C2 capabilities. nembers to enhance various hic tasking process enabled by y for a full-spectrum analysis and undesirable effects. The ill develop non-deterministic, abiguity. Initiate research to on Air Force information apact of cyber attacks on an ize current and future				
(U) (U)	In FY 2009: Continue to investigate application of decision support sciences and advant concepts to C2 activities within a Coalition AOC. Continue to develop intelligent information supporting joint/coalition C2 for various missions in a dynamically changing environment tools to increase situational awareness and understanding through intelligent information application of system-of-systems and federation-of-systems engineering in the creation Continue to explore the application of intelligent software agents as virtual battle staff in C2 processes. Continue the development of capability for a full-spectrum analysis for e of a campaign, linking leading indicators to desired and undesirable effects. The capability and will be capable of reasoning through uncertainty and ambiguity.	aced decision-making mation systems capable of ent. Continue to develop n processing. Continue the of joint C2 capabilities. nembers to enhance various effects attainment at all levels ility will utilize causal , non-linear causal linkages,				
(U)	MAJOR THRUST: Investigate and develop technologies to implement flexible, high per and survivable information management and dissemination services to enable a Global	erformance, secure, scalable, Information Grid-based COI	2.113	2.016	1.898	
Proj	ect 5581 R-1 Line Item Page-21 o 265	No. 16 f 27		Exhibit R-2a	(PE 0602702F)	

	Exhibit R-2a, RDT&E Project Jus	DATE February 2008			
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT N 5581 Com Technolo	UMBER AND TITLE Imand and Con gy	trol (C2)
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Infosphere.				
(U)	In FY 2007: Completed investigation in the use of semantic markup and semantic	web languages as part of the COI			
	Infosphere. Completed investigation of technology and approaches to prioritizing in	nformation in a COI Infosphere			
	so as to effectively utilize communication and computing resources. Developed hig	gn-payoff publish, subscribe, and			
	query laboratory prototypes, which provide higher levels of performance, security, a	and scalability capable of			
	methods of tailoring the user perspective of the COI Infosphere to reduce information	on overload and increase			
	information awareness and utilization. Developed technology and techniques to mo	ponitor, obtain feedback, and assert			
	control over the COI Infosphere. Investigated the security policy enforcement betw	een COI Infospheres at various			
	levels of security classification. Investigated methods and techniques for dynamica	lly evolving the netcentric			
	environment so as to avoid system crashes or latency as new information sources ar	rive or depart the environment.			
(U)	In FY 2008: Continue to develop high-payoff publish, subscribe, and query laborat	ory prototypes, which provide			
	higher levels of performance, security, and scalability capable of exceeding comme	rcial products and support Air			
	Force net-centric environment needs. Continue to investigate automated methods o	f tailoring the user perspective of			
	the COI Infosphere to reduce information overload and increase information awaren	ness and utilization. Continue to			
	develop technology and techniques to monitor, obtain feedback, and assert control of	over the COI Infosphere.			
	Continue to investigate the security policy enforcement between COI infospheres at	t various levels of security			
	classification. Continue to investigate methods and techniques for dynamically evo	the environment Initiate			
	decentralization and fault tolerant information management services for the factical	environment Initiate			
	development of information transformation services and adaptive information mana	gement services that learn.			
	self-configure, self-manage, and are self-healing. Initiate a study on collaboration s	ervices on demand that will			
	exploit dynamic information services matching end user devices (laptops, cell phon	es, etc.) with appropriate			
	information formats.				
(U)	In FY 2009: Continue to develop high-payoff publish, subscribe, and query laborat	ory prototypes, which provide			
	higher levels of performance, security, and scalability capable of exceeding comme	rcial products and support Air			
	Force net-centric environment needs. Develop the security policy enforcement betw	veen COI Infospheres at various			
	levels of security classification. Investigate methods and techniques for dynamicall	y evolving the net-centric			
	environment so as to avoid system crashes or latency by exploiting information tech	nologies based on Quality of			
	Service mechanism. Initiate integration of information services across operational l	ooundaries and dissimilar			
	infrastructure based systems. Continue development of information transformation	services and adaptive			
	R-1 Line	Item No. 16			
Pro	iect 5581 Page	-22 of 27		Exhibit R-2a	(PE 0602702F)
	2	266			

Exhibit R-2a, RDT&E Project Justification	Febru	DATE February 2008		
BUDGET ACTIVITY PE NUMBER AND TITLE 02 Applied Research 0602702F Command Communications	Control and 5581 Command and Technology	PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology		
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> information management services that learn, self-configure, self-manage, and are self-healing.	<u>FY 2007</u> <u>FY 2008</u>	<u>FY 2009</u>		
 (U) (U) MAJOR THRUST/CONGRESSIONAL ADD: Develop distributed collaboration technologies, advance collaboration science, virtual environments, and predictive simulation tools to facilitate the development and find function operational collaborative decision support systems. This effort includes Congressional Add funding of \$1.0 million in FY 2007. 	6.706 5.395 ielding	6.139		
(U) In FY 2007: Developed advanced information technologies for collaborative decision-making and knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments, including data exchange protocols, access privileges and data access. Prototyped distributed collaborative environment technologies for advanced decision support for high-profile system concepts, such a Global Strike Concept of Operations and operations other then war. Conducted Congressionally directed effor Advanced Collaborative Platform for Net-Centric Command and Control (C2).	as the rt for			
(U) In FY 2008: Continue development of advanced information technologies for collaborative decision-making a knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments. Continue to prototype distributed collaborative environment technologies for advance decision support for high-profile system concepts, such as the Global Strike Concept of Operations and operation other then war. Initiate a study on collaboration services on demand that will exploit dynamic information services matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Support context a collaborative user interfaces and semantic interoperability.	and ced ions vices tware			
(U) In FY 2009: Complete development of advanced information technologies for collaborative decision-making a knowledge management in support of capability-based planning and next generation planning, execution, and assessment environments. Complete prototyping distributed collaborative environment technologies for advance decision support for high-profile system concepts, such as the Global Strike Concept of Operations and operation other then war. Continue study on collaboration services on demand that will exploit dynamic information ser matching end user devices (laptops, cell phones, etc.) with appropriate information formats. Support context av collaborative user interfaces and semantic interoperability.	and ced ions vices ware			
(U) Total Cost	48.236 39.620	36.256		
R-1 Line Item No. 16				

		Exhibit R-	2a, RDT&E	Project Jus	stification				DATE February 2008	
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER AND TITLE 0602702F Command Control and Communications			PROJECT NUMBER AND TITLE 5581 Command and Control (C2) Technology		
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons</u>)							
		<u>FY 2007</u> Actual	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimate	<u>FY 2</u> Estir	013 Cost to nate Complete Total Cost	
(U) (U) (U) (U)	Related Activities: PE 0603617F, C3 Applications. PE 0303401F, Communications-Computer Systems (C-CS) Security RDT&E. PE 0603789F, C3I Advanced Development. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.									
(U)	D. Acquisition Strategy Not Applicable.									
Pro	ject 5581			R-1 Line Page	e Item No. 16 e-24 of 27		1		Exhibit R-2a (PE 0602702F)	
					268					

E×	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	E February	2008
BUDGET ACTIVITY 02 Applied Research			₽ 0 0	PE NUMBER AND 0602702F Cor Communication	TITLE nmand Contr ons	ol and	PROJECT NUN 66SP Space	MBER AND TITLE • Optical Netwo	ork Tech
Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
66SP Space Optical Network Tech	15.875	17.105	9.991	8.641	8.885	9.962	9.849	9 Continuing	TBD
Quantity of RDT&E Articles	0				025005 M-14	0	L C) Decise t 5082	Ontinal
Note: In FY 2007, Project 6200SP, Space Optimised Networking Technology in order to more effectively of the space of the s	tively manage a	nd provide over	ts were transfe	fred from PE 00	502500F, Multi	disciplinary S	pace Technolo	ogy, Project 5082	, Optical
between platforms. As the application of communications capacities are thousands emerging communication and information optical Code Division Multiple Access (C associated with the advanced fiber optic, to integrate current Radio Frequency (RF support them. These technologies have p theater level, and multiplexing of multiple	laser-based, poin of times greater n technologies, for CDMA) and Wav wireless, platforr) with high data n otential applicati	nt-to-point com than current co or applications elength Division n, and satellite rate Optical La ons in specific	amunications be ommunications in air and space on Multiplexed networks that ser communica military system tworking infras	etween satellite satellites, beco e. This project (WDM) transc can be built fro ttions, along wi ns including rel structure for red	s emerges, air- me a realistic p will explore te- eivers and prot m them. This p th network mar iable, high ban luced manning	and space-bas ossibility. Thi chnologies for otype network project will dev nagement techn dwidth, jam-re and logistics.	sed optical netwise is project will implementing s, built to dem velop and dem niques, tools as esistant commu	works, whose assess and adapt g photonic chip so nonstrate the bene constrate technolo nd software to unications at the	the cale efits ogy
 (U) <u>B. Accomplishments/Planned Program</u> (U) MAJOR THRUST: Develop and assess (U) In FY 2007: Completed demonstration of router and optical backbone interface chinetwork with 16 x 16 optical data router (U) In FY 2008: Complete demonstration of integration with on board Integrated Commulti-wavelength optical network for on (U) In FY 2009: Continue development of 4 applications. 	n (\$ in Millions) optical network of highly integrat ips. Initiated der and optical back f 16 x 16 optical e Processor. Init -board air and sp 0 channel multi	technologies for ted multi-gigab nonstration of bone interface data router and tiate design and pace application wavelength op	or application in bit optical netwo highly integrate chips. l optical backbo d development ns tical network fo	n the space env ork with 4 x 4 c ed multi-gigabi one interface ch of 40 channel or on-board air	ironment. optical data t optical ips for and space	<u>F</u> }	<u>¥ 2007</u> 1.510	<u>FY 2008</u> 1.510	<u>FY 2009</u> 2.976
 (U) MAJOR THRUST/CONGRESSIONAL modulation schemes and protocols for us million in Congressional Add funding in (U) In FY 2007: Designed and developed op to air- and space-based optical networks 	ADD: Develop se in space-based FY 2007. ptical burst switc . Conducted flig	and assess exis l optical netwo hing and optica ht demonstration	sting and emerg rks. NOTE: T al label switchi on of industry s	ging Optical CI 'his thrust conta ng protocols fo standard single	DMA and WDM ins \$1.1 r applicability mode optical	И	4.045	3.551	1.803
Project 66SP			R-1 Line Iter Page-25	n No. 16 of 27				Exhibit R-2a (I	PE 0602702F)

	Exhibit R-2a, RDT&E Project Justi	fication	DATE February 2008		
BUDG 02 A	ET ACTIVITY pplied Research	PE NUMBER AND TITLE 0602702F Command Control and Communications	PROJECT NI 66SP Spa	JMBER AND TITLE	vork Tech
(U)	B. Accomplishments/Planned Program (\$ in Millions) communications bus interface chip for airborne platforms. Developed and demonstra integrated optical interconnect for space-based optical networking through research p WDM rather than spatial parallelism. Conducted Congressionally-directed effort for Interconnects.	ated a compact, highly lacing greater emphasis on Massively Parallel Optical	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Continue design and development of optical burst switching and optical applicability to air- and space-based optical networks. Complete flight demonstration mode optical communications bus interface chip for airborne platforms	label switching protocols for n of industry standard single			
(0)	chip for space and air platforms.	communications bus interface			
(U)					
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate heterogene self-configuring high capacity air/space/surface wireless networks that integrate curre Optical Laser communications. NOTE: This thrust contains \$1.6 million in Congres	ous, seamless, secure, ent RF with high data rate sional Add funding in FY 2007.	8.163	12.044	5.212
(U)	In FY 2007: Designed and developed waveform, coding, management, and atmospherate a combined RF/laser communications terminal. Demonstrated development of indust communications bus for airborne platforms and air-to-air or air-to-ground RF and lase Developed and demonstrated a tunable chirp managed, directly modulated laser trans rates in free space optical communications. Conducted Congressionally-directed effect Optical Laser Transmitter Modems.	eric mitigation technologies for try standard single mode optical er networked communication. mitter for extremely high data ort for Digital Free-Space			
(U)	In FY 2008: Complete the characterization of the combiner RF/laser communication develop higher throughput RF waveform data link technology for operation under ad Conduct flight demonstration of combined RF/laser communications brassboard in condemonstration of advanced airborne sensor technologies.	s brassboard. Design and verse weather conditions. poperation with the			
(U)	In FY 2009: Complete the development and start the characterization of higher throu technology for operation under adverse weather conditions. Initiate the design of an communications airborne qualifiable brassboard.	ghput RF waveform data link integrated RF/laser			
(U)			2 157	0.000	0.000
(U) (U)	In FY2007: Developed space qualified Common Data Link. to ensure the hardware will have an environmental robustness to operate in the space	e performance of the hardware environment.	2.157	0.000	0.000
(U)	In FY2008: Not Applicable.				
Proi	ect 66SP Page-2	em No. 16 6 of 27		Exhibit R-2a	(PE 0602702E)

		Exhibit R-	2a, RDT&E	Project Ju	stification			DATE	February	2008
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER A 0602702F C Communica	ND TITLE ommand Con ations	trol and	PROJECT NUM	BER AND TITLE Optical Netw	vork Tech
(U) (U)	B. Accomplishments/Planned Pr In FY2009: Not Applicable.	rogram (\$ in Mil	l <u>lions)</u>				F	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	Total Cost							15.875	17.105	9.991
(U)	C. Other Program Funding Sum	mary (\$ in Milli	ons)							
	Polated Activities:	<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> <u>Estimate</u>	FY 2009 Estimate	<u>FY 2010</u> <u>Estimate</u>	FY 2011 Estimate	FY 2012 Estimate	<u>FY 2013</u> <u>Estimate</u>	Cost to Complete	<u>Total Cost</u>
(U) (U)	PE 0603789F, C3I Advanced									
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate									
	duplication.									
	D. Acquisition Strategy Not Applicable.									
Pro	pject 66SP			R-1 Lin Pag	e Item No. 16 e-27 of 27				Exhibit R-2a	(PE 0602702F)
				UNCL	271 ASSIFIED					

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

	Exhib	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDO 02 A	GET ACTIVITY pplied Research			PI 0	E NUMBER AND 602890F Hig	D TITLE h Energy Las	er Research			
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ in Winnons)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	55.580	49.949	49.449	53.561	54.558	55.434	54.855	Continuing	TBD
5096	6 High Energy Laser Research	55.580	49.949	49.449	53.561	54.558	55.434	54.855	Continuing	TBD
(U)	A. Mission Description and Budget Item This program funds Department of Defense have many potential advantages, including requirements. HELs have the potential to p maneuvering anti-ship and anti-aircraft miss funded under this program are chosen for th Service/Agency programs that are directed lasers, free electron lasers, laser beam contri- program is in Budget Activity 2, Applied R technologies.	Justification e (DoD) high en speed-of-light of perform a wide ssiles; and the ut heir potential to at specific Serv rol, and laser let Research, since i	ergy laser (HE lelivery, precis variety of milit tra-precision n have an impac ice needs. A b hality mechani t develops and	L) applied rese ion target enga ary missions in egation of targ t on multiple F proad range of t isms. This prog determines the	earch through the gement, signification of the ets in urban en IEL systems ar echnologies ar gram is part of e technical feas	he HEL Joint T icant magazine eption of ballist vironments wit nd multiple Ser- re addressed in I an overall DoE ibility and milit	echnology Off depth, low-cos ic missiles in b h no/little colla vice missions v key areas such HEL Science tary utility of e	ice (JTO). HEI st per kill, and r poost phase; def ateral damage. while complime as chemical las and Technolog volutionary and	weapon system educed logistics eat of high-spect In general, effor- nting ers, solid state y program. Th I revolutionary	ms s ed, rts is
(U)	B. Program Change Summary (\$ in Mil	<u>lions)</u>					FY 2007	FY	2008	FY 2009
رل)	Previous President's Budget						52.136	50	.303	51.159
(U)	Current PBR/President's Budget						55.580	49	.949	49.449
(U)	Total Adjustments						3.444	-0	.354	
(U)	Congressional Program Reductions							-0	.035	
Ì, į	Congressional Rescissions							-0	.319	
	Congressional Increases									
	Reprogrammings						4.850			
	SBIR/STTR Transfer						-1.406			
(U)	<u>Significant Program Changes:</u> Not Applicable.									
	C. Performance Metrics Under Development.									
				R-1 Line Item Page-1	n No. 17 of 6				Exhibit R-2 (F	PE 0602890F)
				273						

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDG 02 A	GET ACTIVITY pplied Research			P 0 R	PE NUMBER AND 1602890F Higi Research	TITLE h Energy Las	ser	PROJECT NUM 5096 High Ei	BER AND TITLE nergy Laser R	Research
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5096	High Energy Laser Research	55.580	49.949	49.449	53.561	54.558	55.434	54.855	Continuing	TBD
	Quantity of RD1&E Articles	0	0	0	0	0	0	0		
	have many potential advantages, including requirements. HELs have the potential to p maneuvering anti-ship and anti-aircraft mis funded under this program are chosen for t Service/Agency programs that are directed lasers, free electron lasers, laser beam cont program is in Budget Activity 2, Applied F technologies.	speed-of-light perform a wide ssiles; and the u heir potential to at specific Serv rol, and laser le Research, since	delivery, precisivariety of milit ltra-precision r have an impactive vice needs. A b thality mechan it develops and	sion target enga ary missions in negation of targ et on multiple F proad range of t isms. This pro- determines the	agement, signifi acluding interce gets in urban env HEL systems an technologies are ogram is part of e technical feasi	cant magazine ption of ballist vironments with d multiple Serve addressed in I an overall DoD bility and milit	depth, low-co ic missiles in h h no/little coll vice missions key areas such D HEL Science tary utility of e	e and Technolog evolutionary and	reduced logistic feat of high-spe In general, effo enting sers, solid state gy program. Th d revolutionary	s ed, rts is
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Advance solid-state l	(\$ in Millions) laser developme	ent.				<u>F</u>	<u>¥ 2007</u> 14.027	<u>FY 2008</u> 10.271	<u>FY 2009</u> 9.224
(U) (U)	In FY 2007: Participated in the 100 kilow Analyzed successful efforts from applied and fiber laser amplifiers) for future adva In FY 2008: Continue to participate in th government-sponsored measurements of t director suitable for mating with a JHPSS	vatt Joint High I research projec nced demonstra e 100 kilowatt J the 100 kilowatt L device.	Power Solid Sta ts (e. g. long-lif tion of solid sta HPSSL projec lasers. Partici	ate Laser (JHPS fe diode laser d ate laser system t. Provide inde pate in plannin	SSL) demonstra lrivers, thin-disc as. ependent ag for a joint hig	ations. c amplifiers, gh-power beam				
(U) (U)	development of a high-power beam direct	tor suitable for 1	monstrations. nating with a 1	00 kilowatt JH	Cipation in the j IPSSL device.	oint				
(U) (U)	MAJOR THRUST: Mature technologies solid-state laser devices.	that will provid	e system level	performance co	ommensurate w	vith fieldable		7.733	8.232	8.456
(U)	in FY 2007: Developed technology that we beam combination. Improved the efficient proposal call for FY 2007, funded eight p	will lead to impondent to a second to a se	oved laser gain ty of diode pur	n material and s np sources. Co	single mode fib onducted Servic	ers suitable for e and Agency				
(U)	In FY 2008: Develop technology that will power scaling architectures with good bea	Il lead to improv am quality and s	ved fieldability suitable mass a	, serviceability, nd weight. Cor	, and ruggednes nduct an industr	s. Develop ry proposal call	l			
Proj	ect 5096			R-1 Line Iten Page-2	n No. 17 of 6				Exhibit R-2a (I	PE 0602890F)

	· •			February	y 2008
BUDGET ACTIVITY 02 Applied Research		PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT N 5096 High	IUMBER AND TITLE Energy Laser	E Research
(U) B. Accomplishments/P for FY 2008.	lanned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Develop to power scaling architectu reliability of diode pum call for FY 2009.	echnology that will lead to improved fieldability, sources with good beam quality and suitable mass and p sources. Investigate eye-safer laser technologies	erviceability, and ruggedness. Develop weight. Improve the efficiency and . Conduct Service and Agency proposal			
(U)			• 400		
 (U) MAJOR THRUST: Inv (U) In FY 2007: Explored r short-pulse laser techno three projects. 	logy into this initiative. Conducted a Service and	potential for HEL applications. decrease mass/volume. Integrated Agency proposal call for FY 2007, funded	2.189	2.411	2.423
(U) In FY 2008: Explore no proposal call for FY 200	ovel laser technologies to increase efficiency and d	ecrease mass/volume. Conduct an industry			
(U) In FY 2009: Explore no and Agency proposal ca	ovel laser technologies to increase efficiency and d ll for FY 2009.	ecrease mass/volume. Conduct a Service			
(U)				· ·-··	
(U) MAJOR THRUST: Exp	plore free electron lasers (FEL) that have potential	in future HEL weapons. Conduct system	9.463	9.674	9.923
shipboard integration.	phient and trade studies to facilitate scaling FEEs (to weapons-class power levels and			
(U) In FY 2007: Demonstra	ated high average current photocathode and injecto	r capability, suitable beam-breakup			
thresholds, and power so define a development pa	caling of the optical resonator. Continued compon ath for scaling to 100 kilowatts. Conducted a Servi	ent testing with the 14 kilowatt device to ice and Agency proposal call for FY 2007,			
funded six projects.					
(U) In FY 2008: Continue t	o investigate the development path for scaling to a	100 kilowatt lab demonstration. Conduct			
(II) In FY 2009: Continue t	o investigate the development path for scaling to a	100 kilowatt lab demonstration Conduct			
a Service and Agency p	roposal call for FY 2009.	100 knowatt hab demonstration. Conduct			
(U)					
(U) MAJOR THRUST: Corregeneration technologi	nduct technology experiments to select promising on the scaled for weapons application.	chemical generator and chemical	7.303	5.690	5.957
(U) In FY 2007: Demonstra	ated closed-cycle chemical oxygen-iodine laser dev	vice. Demonstrated electric-oxygen			
pumping schemes to mi	nimize the chemistry. Developed electric-gas phase	se laser generation technologies.			
		R-1 Line Item No. 17			
Project 5096		Page-3 of 6		Exhibit R-2a	(PE 0602890F)

	Exhibit R-2a, RDT&E Project Justi	fication	D	February	y 2008
BUD(02 A	GET ACTIVITY Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT N 5096 High	UMBER AND TITLE • Energy Laser	Research
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Investigate closed-cycle chemical lasers. Explore novel concepts on ele	ctric-gas phase laser generation.			
	Conduct an industry proposal call for FY 2008.				
(U)	In FY 2009: Investigate closed-cycle chemical lasers. Explore novel concepts on ele	ctric-gas phase laser generation.			
	Conduct a Service and Agency proposal call for FY 2009.				
(U)					
(U)	MAJOR THRUST: Develop technology to support high performance beam control sy demonstrations.	ystems and integrated	8.918	9.615	9.460
(U)	In FY 2007: Developed beam control technologies, such as an all-fiber laser with con-	formal apertures and active			
	controls for boundary layer mitigation. Demonstrated atmospheric compensation tech	nnologies. Conducted a Service			
	and Agency proposal call for FY 2007, funded eight projects.				
(U)	In FY 2008: Develop/provide beam control technology options for laser weapon use	on multiple platforms (aircraft,			
	ground vehicles and shipboard systems). Conduct an industry proposal call for FY 2	008.			
(\mathbf{U})	In FY 2009: Participate in a joint high-power beam director development effort, suita	ble for mating with a 100			
	knowait JHPSSL laser device. Develop/provide beam control technology options for platforms (aircraft, ground vahigles and shipboard systems). Explore advanced comp	aser weapon use on multiple			
	for difficult environments such as high speed flight high turbulence, and extended rai	ages Conduct a Service and			
	Agency proposal call for FY 2009.	iges. Conduct à Service and			
(U)					
(U)	MAJOR THRUST: Develop a lethality database, and integrate it into a systems-level	architecture plan.	3.814	4.056	4.006
(U)	In FY 2007: Cataloged existing lethality databases for common use. Developed an a	rchitecture plan to consolidate			
	and compare historical data. Initiated laser systems inputs for the Joint Munitions Eff	ect Manual.			
(U)	In FY 2008: Integrate lethality data into campaign-level HEL system models. Develo	op laser systems inputs for the			
	Joint Munitions Effect Manual.				
(U)	In FY 2009: Integrate lethality data into campaign-level HEL system models. Develo	op databases that will be			
	accepted by the HEL community and integrate in validated models for laser systems of	lesigners. Develop laser			
	systems inputs for the Joint Munitions Effect Manual.				
(\mathbf{U})	CONCRESSIONAL ADDU Air Losser Technology Development		0 122	0.000	0.000
(0)	In EV 2007: Investigated production of oxygen deltlets through electric numping		2.155	0.000	0.000
	In FY 2008: Not Applicable				
	in a 2000. Not Application				
	R-1 Line Ite	em No. 17			
Pro	Page-4	4 of 6		Exhibit R-2a	(PE 0602890F)
	27	6			

		Exhibit R-	2a, RDT&E	Project Jus	stification			DAT	February	2008	
BUD 02 /	GET ACTIVITY Applied Research				PE NUMBER AND TITLE PROJE 0602890F High Energy Laser 5096 Research				ECT NUMBER AND TITLE High Energy Laser Research		
(U) (U)	B. Accomplishments/Planned Pr In FY 2009: Not Applicable.	<u>cogram (\$ in Mil</u>	<u>lions)</u>				<u>F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	Total Cost							55.580	49.949	49.449	
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u>	ons)								
		FY 2007 Actual	<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	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	Total Cost	
(U)	PE 0601108F, High Energy Laser Research Initiatives.										
(U)	PE 0603444F, Maui Space Surveillance System.										
(U)	PE 0603605F, Advanced Weapons Technology.										
(U)	PE 0603924F, High Energy Laser Advanced Technology Program										
(U)	PE 0603883C, Ballistic Missile Defense Boost Phase Segment.										
(U)	PE 0602605F, Directed Energy Technology.										
(U)	PE 0602307A, Advanced Weapons Technology.										
(U)	PE 0602114N, Power Projection Applied Research.										
(U)	PE 0602120A, Sensors and Electronic Survivability.										
(U)	PE 0603004A, Weapons and Munitions Advanced										
(U)	PE 0602702E, Tactical										
(U)	PE 0603175C, Ballistic Missile Defense Technology.										
Pro	oject 5096			R-1 Line Pag	e Item No. 17 ge-5 of 6				Exhibit R-2a	(PE 0602890F)	
					277						

BUDGET ACTIVITY 02 Applied Research PROJECT ACTIVITY PENUMBER AND TITLE 0002651PHigh Energy Laser PROJECT NUMBER AND TITLE 000261PHigh Energy Laser PROJECT NUMBER	Exhibit R-2a, RDT&E Project Justification DATE February 2008											
U) C. Other Program Funding Summary (5 in Millions) (U) PE 0602651M, Joint Non-Lethal Weapons Technology Person Development. (1) (U) Display for the been coordinated through the Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. Not Applicable.	BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602890F High Energy Laser Research	PROJECT NUMBER AND TITLE 5096 High Energy Laser Research									
Project 5096 Page-6 of 6 Exhibit R-2a (PE 0602890F)	 (U) C. Other Program Funding Summary (\$ in Millions) (U) PE 0602651M, Joint Non-Lethal Weapons Applied Research. (U) PE 0603651M, Joint Non-Lethal Weapons Technology Development. (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. 	R-1 Line Item No. 17										
	Project 5096	Page-6 of 6	Exhibit R-2a (PE 0602890F)									

PE NUMBER: 0603112F PE TITLE: Advanced Materials for Weapon Systems

	Exhil	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDGE 03 Ad	T ACTIVITY vanced Technology Development (ATD)		PE 0	E NUMBER AND 603112F Adv	TITLE	ials for Weap	oon Systems	\$ 	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate 42 004	Estimate	Estimate	Complete	
2100	Total Program Element (PE) Cost	83.546	54.8/1	41.926	45.030	43.904	46.278	46.165	Continuing	TBD
2100	Non-Destructive Inspection	32.202	25.443	24.152	28.162	29.300	30.491	30.452	Continuing	IBD
3153	Development	16.657	7.424	4.185	4.335	4.393	4.749	4.705	Continuing	TBD
3946	Materials Transition	15.652	11.268	4.459	6.654	4.242	4.584	4.512	Continuing	TBD
4918	Deployed Air Base Demonstrations	13.919	6.374	5.918	2.550	2.592	2.802	2.876	Continuing	TBD
77SP	Advanced Space Materials	5.116	4.362	3.212	3.329	3.377	3.652	3.620	Continuing	TBD
no ca S T S B do	on-structural materials for aerospace appl apabilities; and (5) advanced materials for system, \$1.0 million for Encapsulated Bal echnology, \$2.0 million for Aircraft Eval upply Program, \$0.5 million for Material udget Activity 3, Advanced Technology evelopments that have military utility and	ications; (4) airl r space applicati listic Protection uation Readines s Integrity Mana Development, si l address warfigl	base operations ons. Note: In System (EBPS is Initiative (Af- agement Resear- ince it develops hter needs.	s technologies i FY 2008, Cong (), \$1.0 million ERI), \$5.0 milli rch, and \$1.6 m s and demonstra	ncluding deplo gress added \$1. for Coated Fie ion for Metals <i>i</i> iillion for Body ates technologi	yable base infra .2 million for C .ld Repair (2K C Affordability In / Armor Improv tes for existing	astructure, forc ontinuous Inte Gun), \$1.6 mill ititative, \$1.6 n /ed Ballistic Pr system upgrade	e protection, a grated Vehicle ion for EMI C nillion for Stra otection. This es and/or new	nd fire fighting Health Monito Frid Fabrication tegic Bio-fuels program is in system	ring
(U) <u>I</u>	B. Program Change Summary (\$ in Mi	<u>llions)</u>					EV 2007	EV	2009	EV 2000
(U) H	Previous President's Budget						<u>FY 2007</u> 82.290	<u>FY</u> 3	<u>2008</u> 9.730	<u>FY 2009</u> 39.324
(U) (U)	Current PBR/President's Budget						83.546	5	4.871	41.926
(U) 7	Total Adjustments						1.256	1	5.141	
(U) (Congressional Program Reductions									
(Congressional Rescissions							-	0.359	
(Congressional Increases							3	2.300	
F	Reprogrammings						3.245	-1	6.800	
5	BIR/STTR Transfer						-1.989			
(U) <u>S</u>	Significant Program Changes:									

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Exhibit R-2, RDT&E	E Budget Item Justification	DATE February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for	r Weapon Systems
Not Applicable.		
C. Performance Metrics		
Under Development.		
	R-1 Line Item No. 18 Page-2 of 17	Exhibit R-2 (PE 0603112F)
	R-1 Line Item No. 18 Page-2 of 17 280	Exhibit R-2 (PE (

	Ext	hibit R-2a, F	DT&E Pro	ject Justif	ication			DATE	February	2008	
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)		F Q V	PE NUMBER AND 1603112F Adv Veapon Syste	TITLE anced Mater ems	als for	PROJECT NUME 2100 Laser H	ROJECT NUMBER AND TITLE 100 Laser Hardened Materials		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total	
2100	D Laser Hardened Materials	32.202	25.443	24.152	28.162	29.300	30.491	30.452	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
(U) (U) (U)	A. Mission Description and Budget Item This project develops and demonstrates ad perform required missions in threat environ systems to ensure safety, survivability, and <u>B. Accomplishments/Planned Program</u> MAJOR THRUST/CONGRESSIONAL	Justification vanced material nments. Advance l operability in the <u>(\$ in Millions)</u> ADD: Develop	s technologies ed materials te nreat environm and demonstra	that enhance p echnologies are ents. te advanced m	rotection for Ai e also developed aterials technolo	r Force aircrew l and demonstr ogies that	rs to ensure sa ated to enhanc <u>FY</u>	fety and to enable be protection for <u>7 2007</u> 24.827	le aircrews to Air Force sens <u>FY 2008</u> 19.683	or <u>FY 2009</u> 17.834	
(U) (U) (U)	 In FY 2008: Developed protection strategies for large format CCDs. In FY 2008: Developed protection strategies for large format CCDs. In FY 2008: Demonstrate mature hardening materials technology for an Air Force tactical system. Characterize and incorporate candidate dual band limiter materials for tactical systems. Demonstrate protection strategies for large format CCDs. In FY 2009: Transition mature hardening materials technology for an Air Force tactical system. Demonstrate performance of dual band limiter materials in tactical systems. 										
(U) (U) (U) (U)	MAJOR THRUST/CONGRESSIONAL A enhance protection for Air Force aircrews threat environment. Note: This effort inc Filters for Hardened Night Vision Goggle In FY 2007: Demonstrated brassboard pe Characterized and incorporated agile filte In FY 2008: Validate performance of stat configuration. Optimize agile filter and o In FY 2009: Transition advanced agile fil Demonstrate agile filter and optical limite	ADD: Develop s to ensure safety cludes Congressi es (NVGs). erformance using r and optical lim te-of-the-art agil optical limiter de lters and optical er devices for Ai	and demonstra v and to enable onal Add fund g state-of-the-a iter technologi e filters and op vices for Air F power limiters r Force applica	te advanced m aircrews to pe ing of \$1.0 mi rt agile filters tes into devices otical power lin orce applications technologies attions.	aterials technolo orform required llion in FY 2007 and optical pow s for Air Force a niters in a syste ons. in a system cont	ogies that missions in a 7 for Optical er limiters. applications. m figuration.		7.375	5.760	6.318	
(U)	Total Cost		F F					32.202	25.443	24.152	
Pro	ject 2100			R-1 Line Iter Page-3 0 281	n No. 18 of 17				Exhibit R-2a (PE 0603112F)	

		Exhibit R-	2a, RDT&E	Project Ju	stification			DATE	February 2008
BUD 03	GET ACTIVITY Advanced Technology Develop	PROJECT NUME 2100 Laser H	T NUMBER AND TITLE aser Hardened Materials						
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u>	<u>ons)</u>						
		FY 2007 Actual	<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> Estimate	<u>Cost to</u> Complete <u>Total Cost</u>
(U) (U) (U) (U)	Related Activities: PE 0602102F, Materials. PE 0602202F, Human Effectiveness Applied Research. PE 0603231F, Crew Systems and Personnel Protection Technology. PE 0603500F, Multi-Disciplinary Advanced Development Space Technology. PE 0604706F, Life Support								
(U) (U)	Systems. This project has been coordinated through the Tri-Service Laser Hardened Materials and Structures Group and the Joint Service Agile Laser Eye Protection Program. This project has been								
	coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.								
	D. Acquisition Strategy Not Applicable.								
Pro	ject 2100			R-1 Line Pac	e Item No. 18 e-4 of 17				Exhibit R-2a (PE 0603112F)
					282				
Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	cation			DATE	February	2008
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BUDGET ACTIVITY 03 Advanced Technology Development ((ATD)		P 0 V	e NUMBER AND 603112F Adv Veapon Syste	TITLE anced Mater	ials for	PROJECT NUME 3153 Non-De Developmen	BER AND TITLE Structive Insp t	pection
Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3153 Non-Destructive Inspection Development	16.657	7.424	4.185	4.335	4.393	4.749	4.705	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(0) A. Mission Description and Budget item This project develops and demonstrates ad causing conditions in weapon systems con practices. This project provides technolog cost-effectiveness at field and depot maint	lvanced nondestr apponents and ma by to satisfy Air l enance levels. E	uctive inspecti terials. NDI/E Force requirem Equally importa	on/evaluation (capabilities gr ents to extend ant is assuring r	(NDI/E) techno eatly influence the lifetime of o manufacturing o	logies to monit and/or limit m current systems quality, integrit	tor performanc any design, ma s through incre ty, and safety r	e integrity and anufacturing, ar ased reliability equirements.	to detect failure ad maintenance and	
 (U) <u>B. Accomplishments/Planned Program</u> (U) MAJOR THRUST: Develop and demonstration and other damage to extend the total safe (U) In FY 2007: Transitioned methods to detengine components. Transitioned enhance (U) In FY 2008: Develop NDI/E approaches (U) In FY 2009: Validate NDI/E approaches (U) In FY 2009: Validate NDI/E approaches 	(\$ in Millions) strate advanced to life of turbine en- tect and characted ced NDI/E appro- to extend the life to extend the life	echnologies to ngines. rize damage in aches to exten- e of fracture-cu e of fracture-cu	improve capat repaired (linea d the life of sup ritical gas turbin ritical gas turbin	bilities to insper or friction weld peralloy engine ne engine comp ne engine comp	ct for cracks ed) turbine components. ponents.	FY	<u>7 2007</u> 0.890	<u>FY 2008</u> 0.483	<u>FY 2009</u> 0.527
 (U) MAJOR THRUST: Develop and demonstry systems to enhance affordability and ensurement of the systems to enhance affordability and ensurement and repair of LO materials and the systems and the systems and the systems of t	strate advanced i ure full performa ltifunctional, mu d structures. nultiuse, multipla latform LO NDL	nspection tech nce and surviv ltiplatform dia tform LO ND E hand tool th	nologies suppo ability. gnostics tool fo I/E hand tool th at meets user re	rting low-obser or use in battle at meets user re equirements.	rvable (LO) damage equirements.		0.315	0.264	0.339
 MAJOR THRUST/CONGRESSIONAL capabilities in materials corrosion, fatigue maintenance costs. These technologies v effort includes Congressional Add fundir National Institute for Aviation Research Inspection and Analysis Methods for Agi Techniques for Assessing Aging Military 	ADD: Develop e monitoring, an vill contribute to og of \$7.0 million a, \$2.0 million fo ng Military Airco Aircraft).	and demonstra d testing of agi full operability n in FY 2007 (r Assessing A raft, and \$1.0 p	te advanced tec ng aircraft to re y and safety of \$2.0 million for ging of Military million for Qua	chnologies for i educe operatior the aircraft flee r Aging Aircraf v Aircraft, \$2.0 ntitative Inspec	mproved as and et. Note: This ft Fleet Support million for ction	t	8.114	1.621	1.739
Project 3153			R-1 Line Item	n No. 18					

	Exhibit R-2a, RDT&E Project Justif	ication	DA	TE February	/ 2008	
BUDG 03 A	ET ACTIVITY F dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 3153 Non-Destructive Inspection Development			
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Demonstrated application-focused NDI/E technologies to meet emerging aging aircraft	g inspection requirements for				
(U)	In FY 2008: Validate NDI/E technologies to meet emerging inspection requirements f	for aging aircraft and develop				
(-)	processes.					
(U)	In FY 2009: Transition application-focused NDI/E technologies to meet emerging ins aircraft.	pection requirements for aging				
(U)						
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advanced sy technologies to provide on-board and embedded sensing to gain continuous awareness Note: This effort includes Congressional Add funding of \$2.0 million in FY 2007 (\$1 Integrity Management Research for AF Systems and \$1.0 million for Continuous Integ Monitoring System).	ystems status monitoring s of the state of key subsystems. .0 million for Materials grated Vehicle Health	3.322	1.380	1.580	
(U)	In FY 2007: Validated optimal sensing approaches for real-time health monitoring of systems and characterized power scavenging and signal transmission issues. Validated wiring health analysis. Validated field-level inspection tools for assessing the structure	high-temperature protection d smart sensor technologies for ral health of airframes.				
(U)	In FY 2008: Develop optimal sensing approaches for real-time health monitoring of h systems and characterize power scavenging and signal transmission issues. Develop in technologies for wiring health analysis. Develop data fusion to be used with field-leve the structural health of airframes.	high-temperature protection mproved, smaller smart sensor el inspection tools for assessing				
(U)	In FY 2009: Develop optimal sensing approaches for real-time health monitoring of h systems and characterize power scavenging and signal transmission issues. Transition wiring health analysis. Transition total field-level inspection tool for assessing the stru-	high-temperature protection a smart sensor technologies for uctural health of airframes.				
(U)						
(U)	CONGRESSIONAL ADD: Low Observable Multi-Purpose Inspection Tool.		0.972	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Low Observable Multi-Pu	rpose Inspection Tool.				
(U)	In FY 2008: Not Applicable					
(U)	In T 2009. Not Applicable.					
(U)	CONGRESSIONAL ADD: Improved Stealth Aircraft Availability/Functionality.		1.944	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Improved Stealth Aircraft	Availability/Functionality.				
(U)	In FY 2008: Not Applicable.					
	R-1 Line Ite	m No. 18				
Proj	ect 3153 Page-6	of 17		Exhibit R-2a	(PE 0603112F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008		
BUD(03 A	UDGET ACTIVITY PE NUMBER AND TITLE 3 Advanced Technology Development (ATD) 0603112F Advanced Materials fo Weapon Systems								PROJECT NUMBER AND TITLE 3153 Non-Destructive Inspection Development			
(U) (U)	B. Accomplishments/Planned Pro In FY 2009: Not Applicable.	gram (\$ in Mil	lions)					FY 2007	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	CONGRESSIONAL ADD: Advand Widespread Fatigue Damage in Agi		1.100	0.000	0.000							
(U) (U)	In FY 2007: Conducted Congressic for Multi-layer Structures and Wide In FY 2008: Not Applicable.	onally-directed e spread Fatigue	effort for Advan Damage in Agin	ced Inspection 7	rechniques and raft.	Analysis Method	S					
(U) (U)	In FY 2009: Not Applicable.											
(U) (U) (U)	CONGRESSIONAL ADD: Aircraf In FY 2007: Not Applicable.	ft Evaluation Re	adiness Initiativ	ve (AERI).				0.000	1.987	0.000		
(U) (U) (U)	In FY 2009: Not Applicable.	iny-unected en	on for ALKI.									
(U) (U) (U)	CONGRESSIONAL ADD: Contin In FY 2007: Not Applicable. In FY 2008: Conduct Congressiona In FY 2009: Not Applicable	uous Integrated	Vehicle Health ort for Continue	Monitoring Sys	tem. ehicle Health M	onitoring System		0.000	1.192	0.000		
(U) (U) (U)	CONGRESSIONAL ADD: Materia In FY 2007: Not Applicable.	als Integrity Ma	nagement Rese	arch.				0.000	0.497	0.000		
(U) (U) (U)	In FY 2008: Conduct Congressiona In FY 2009: Not Applicable.	ally-directed eff	ort for Materials	s Integrity Mana	gement Researc	h.						
(U)	Total Cost							16.657	7.424	4.185		
(U)	C. Other Program Funding Summ	ary (\$ in Millio	ons)									
		<u>FY 2007</u> <u>Actual</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> <u>Complete</u>	<u>Total Cost</u>		
(U) (U) (U)	Related Activities: PE 0602102F, Materials. This project has been											
Proj	ect 3153			R-1 Line Pag	e Item No. 18 e-7 of 17				Exhibit R-2a ((PE 0603112F)		

Exhibit R-2a, RDT&E Project Justification								
PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 3153 Non-Destructive Inspection Development							
R-1 Line Item No. 18								
	Oject Justification							

	Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDG 03 Ac	ET ACTIVITY Ivanced Technology Development	(ATD)		P 0 V	E NUMBER AND 603112F Adv Veapon Syste	TITLE vanced Mater ems	ials for	PROJECT NUME 3946 Materia	BER AND TITLE	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
2046	Madanial Transition	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	TDD
3946	Materials Transition	15.652	11.268	4.459	6.654	4.242	4.584	4.512	Continuing	IBD
			0	0	0	0	0	0		
2 1 1	This project develops and demonstrates ad applications. Advanced materials and pro- proposed operating environment are perfor- providing needed initial incentives for the	dvanced material pocesses that have prmed. These des prir industrial deve	s and processir matured beyon sign and scale- lopment.	ng technologies nd applied resea up data improv	s for fielded and arch are charact re the overall af	l planned Air F terized, critical fordability of p	force weapon, data are collect romising mate	airframe, and pr cted, and critical crials and proces	opulsion evaluations in sing technolog	the ies,
(U)	B. Accomplishments/Planned Program	<u>n (\$ in Millions)</u>					<u>FY</u>	<u>2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	technologies for air vehicles and subsyst affordability of air vehicles. Note: This Metals Affordability Initiative. In FY 2007: Developed materials-dama, capability. Completed transition of high Characterized advanced materials and m assessed process repeatability for power functionality of integrated methods for a flexible/lightweight conductive gap filler aircraft areas. Demonstrated primer/seal areas on emerging fighter aircraft. Evalu structure repair materials. Demonstrated In EX 2008: Validate materials-damage	ems to enhance the effort includes C ge predictive app -temperature org aterials process or generation mater mid-infrared lass r. Evaluated proce ler material for in lated improved p l nondestructive en predictive appro-	he lift, propuls congressional A roaches for enganic matrix con apabilities for ials for airborn er source enable cesses for remo- proved durabi rocessing of ro evaluation tool aches for engin	ion, low-observ Add funding of gine health deter mposites for tur scaled-up proce he directed ener ling aircraft cou oval of radar ab ility of LO mate com-temperatur for limited acc	vable performant \$2.3 million in ermination and rbine engine co- essing technique rgy weapons. If untermeasures. sorbing materia- erials in fluid co- re-storable rada cess areas on air pination and life	nce, and overal FY 2007 for life extension imponents. les and Demonstrated Demonstrated al on large ontaminated r absorbing ceraft.	1			
(U)	capability. Transition advanced materials power generation materials for airborne of component-level demonstrations of new new aircraft self-protection schemes. Tr materials and processing technologies fo propulsion applications as well as suppor infrastructure. In FY 2009: Validate materials-damage	Is and materials p directed energy v material for enab ransition flexible/ or transition to fie rt systems includ predictive appro	veapons. Trans ling mid-IR la lightweight co lded and plann ing Air Force M aches for engir	ities for compo sition materials ser output with nductive gap fi ed Air Force w Material Comm	and processing a energy sufficient ller. Validate a veapon, airfram hand (AFMC) c	onstrations of g concepts for ent for enabling idvanced e, and renter	y 2			
Proje	ct 3946			R-1 Line Iten Page-9 c	n No. 18 of 17				Exhibit R-2a (I	PE 0603112F)

	Exhibit R-2a, RDT&E Project J	ustification	DA	February	/ 2008	
BUDC 03 A	BT ACTIVITY dvanced Technology Development (ATD)	PROJECT NUMBER AND TITLE 3946 Materials Transition				
(U)	B. Accomplishments/Planned Program (\$ in Millions) capability. Transition advanced materials and processing technologies to fielded airframe, and propulsion applications as well as support systems including AFM domestic lithium ion precursor materials, active materials, associated testing, and acceleration of industrial development.	l and planned Air Force weapon, C center infrastructure. Evaluate l battery-cell manufacturing for	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate advan technologies to enhance the sustainability of Air Force aerospace systems by lov costs and ensuring the full operability and safety of systems and personnel. Note Add funding of \$1.0 million in FY 2007 for Coated Field Repair.	ced materials and processing vering operations and maintenance e: This effort includes Congressional	1.648	0.218	1.112	
(U)	In FY 2007: Developed test methodologies and evaluation techniques to facilita and processes for sustainment of Air Force systems	te transition of emerging materials				
(U)	In FY 2008: Identify and prioritize critical issues that are preventing transition of for sustainment of Air Force systems.	f emerging materials and processes				
(U)	In FY 2009: Develop test methodologies and evaluation techniques to facilitate processes for sustainment of Air Force systems.	transition of emerging materials and				
(U)						
(U) (U)	CONGRESSIONAL ADD: Advanced Power Technology: Silicon Carbide Pow In FY 2007: Conducted Congressionally-directed effort for Advanced Power Te Bipolar Junction Transistors.	er, Bipolar Junction Transistors. echnology: Silicon Carbide Power,	1.750	0.000	0.000	
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.					
(U) (U)	CONGRESSIONAL ADD: Silicon Carbide Electronics Material Producibility I In FY 2007: Conducted Congressionally-directed effort for Silicon Carbide Elec Initiative.	nitiative. etronics Material Producibility	5.638	0.000	0.000	
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Metals Affordability Initiative.		0.000	4.968	0.000	
(U)	In FY 2007: Not Applicable.					
(U)	In FY 2008: Conduct Congressionally-directed effort for Metals Affordability In	nitiative.				
Proj	ect 3946 R-1 L	ine Item No. 18 age-10 of 17		Exhibit R-2a	(PE 0603112F)	

		Exhibit R-2	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUD(03 A	GET ACTIVITY Advanced Technology Develop		PE NUMBER AND TITLE PROJEC 0603112F Advanced Materials for 3946 I Weapon Systems				CT NUMBER AND TITLE Materials Transition			
(U) (U)	B. Accomplishments/Planned Pr In FY 2009: Not Applicable.	<u>ogram (\$ in Mill</u>	<u>lions)</u>				E	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U)	CONGRESSIONAL ADD: Coate In FY 2007: Not Applicable. In FY 2008: Conduct Congression	ed Field Repair (2 nally-directed effo	K Gun). ort for Coated F	ield Repair (2K	Gun).			0.000	0.993	0.000
(U) (U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: EMI In FY 2007: Not Applicable. In FY 2008: Conduct Congression In FY 2009: Not Applicable.	Grid Fabrication	Fechnology. ort for EMI Grid	d Fabrication Te	chnology.			0.000	1.589	0.000
(U) (U)	Total Cost							15.652	11.268	4.459
(U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602102F, Materials. PE 0603203F, Advanced Aerospace Sensors. PE 0603211F, Aerospace Technology Dev/Demo. PE 0603216F, Aerospace Propulsion and Power Technology. PE 0603500F, Multi-Disciplinary Advanced Development Space Technology. This project has been coordinated through the	<u>mary (\$ in Millio</u> <u>FY 2007</u> <u>Actual</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>
Pro	ject 3946		_	R-1 Line Page	Item No. 18 -11 of 17 289				Exhibit R-2a	(PE 0603112F)

Exhibit R-2a, RDT&E	Project Justification	February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NUMBER AND TITLE 3946 Materials Transition
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> harmonize efforts and eliminate duplication.		
U) D. Acquisition Strategy Not Applicable.		
Project 3946	R-1 Line Item No. 18 Page-12 of 17 290	Exhibit R-2a (PE 0603112

	Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDG 03 A	ET ACTIVITY dvanced Technology Development ((ATD)		P 0 V	e number and 603112F Adv Veapon Syste	o TITLE vanced Mater ems	ials for	PROJECT NUME 4918 Deploye Demonstratio	BER AND TITLE ed Air Base ons	
	Cost (\$ in Millions)	FY 2007	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total
4918	Deployed Air Base Demonstrations	13 919	6 374	5 918	2 550	2 592	2.802	2. 2.876	Continuing	TBD
.,,10	Quantity of RDT&E Articles	0	0	0	0	0	0	0	Continuing	122
(U)	A. Mission Description and Budget Item This project develops and demonstrates ad costs, and improve protection and survival demonstrated to provide deployable infras	<u>1</u> Justification lvanced, rapidly bility of deploye tructure_adyanc	deployable air d Air Expeditio	base technolog bary Force (A	ies that reduce a EF) warfighters	airlift and man s. Affordable, and fire fightir	power require efficient techn	ments, setup tim ologies are deve or deployed AE	nes, and sustain eloped and E operations	ment
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST/CONGRESSIONAL infrastructure technologies that reduce air support of AEF operations. Note: In FY This effort includes Congressional Add fr Alaska.	(\$ in Millions) ADD: Demonst rlift and manpov 2009, this effor unding of \$3.3 n	rate and transit ver requiremen t increases emp nillion in FY 20	ion advanced r ts, setup times, bhasis on airfiel 007 for Hydrot	apidly deploya , and sustainme ld damage repa hermal Oxidation	ble airbase nt costs in ir technologies on (HTO) for		<u>Y 2007</u> 4.680	<u>FY 2008</u> 0.897	<u>FY 2009</u> 4.395
(U)	In FY 2007: Demonstrated a 10 kW fuel Demonstrated packed bed fuel treatment ventilation, and air conditioning concept. crater/spall repair materials and methodo	cell power syste technology. De Developed con logies for impro	em that improv monstrated adv ntinuous load d ved airfield ass	es deployable p anced integrate eflection techn essment and ra	power systems power systems ped shelter power solution of the system of the power syst	performance. er/heating, roved				
(U)	In FY 2008: Develop transition plan and catalytic and surface chemistry technolog continuous load deflection technologies a	specifications for gies for application and improved cra	or system deve on to bare base ater/spall repair	lopment and de utilities. Deve	emonstration. (elop and demon	Characterize Istrate				
(U)	In FY 2009: Develop best methods for in ensure processes for innovative technolog Begin development and demonstration of conditions, represented by key performant and repair in the field.	ntegration of adv gies. f airfield damage nce parameters, i	repair and ma ncluding issues	eneration and o tting technolog	distribution. Cl gies that address weight and ease	haracterize and s field critical e of installation				
(U) (U)	MAJOR THRUST: Demonstrate and tra fighting capability for deployed AEF ope In FX 2007: Demonstrated improved bla	nsition affordable trations.	e, efficient tec	hnologies to pr	ovide force pro	stection and fire	2	1.487	1.306	1.523
	and existing structures and for explosive technologies and transitioned technology	storage facilities to operational u	. Completed d nits. Initiated	emonstration c an integrated cr	of improved fire rash/rescue fire	e fighter safety fighting				
Proje	ect 4918			R-1 Line Iten Page-13	n No. 18 of 17				Exhibit R-2a (PE 0603112F)

	Exhibit R-2a, RDT&E Project Jus	DA	TE February	2008		
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems	PROJECT NU 4918 Depl Demonstr	PROJECT NUMBER AND TITLE 4918 Deployed Air Base Demonstrations		
(U)	B. Accomplishments/Planned Program (\$ in Millions)	ionomu structures	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2008: Develop and analyze effectiveness of improved blast suppression tech protection materials for new and existing structures. Demonstrate explosives detec technical orders and construction standards supporting fire suppression technologie technologies. Evaluate ultrahigh pressure, standoff nozzles, and other innovative te Develop air filtration and model/evaluate reactive filtration effectiveness for expedi-	inologies and fragmentation tion technologies. Transition s for fire fighter safety echnologies with test bed vehicles. itionary structures.				
(U)	In FY 2009: Validate and fabricate improved blast suppression technologies and fr for new and existing structures. Demonstrate and validate explosives detection tech characterize improved fire fighter safety technologies and transition technology to e and analyze/evaluate ultrahigh pressure, standoff nozzles, and other innovative tech Characterize air filtration and model/evaluate reactive filtration effectiveness for ex-	agmentation protection materials mologies. Evaluate and operational units. Characterize mologies with test bed vehicles. peditionary structures.				
(U)						
(U) (U)	CONGRESSIONAL ADD: Blast Resistant Barriers and Structural Design for Hom In FY 2007: Conducted Congressionally-directed effort for Blast Resistant Barrier	neland Defense. s and Structural Design for	1.264	0.000	0.000	
	Homeland Defense.					
(0)	In FY 2008: Not Applicable.					
	III I I 2009. Not Applicable.					
(U)	CONGRESSIONAL ADD: Body Armor Improved Ballistic Protection.		1.361	1.589	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Body Armor Underarn Materials.	and Side Protection with Smart	1.501	1.007	0.000	
(U)	In FY 2008: Conduct Congressionally-directed effort for Body Armor Improved B	allistic Protection.				
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Combined Agent Fire Fighting System.		0.972	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Combined Agent Fire	Fighting System.				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(\mathbf{U})	CONCRESSIONAL ADD: Encongulated Pollistic Protection System (EPDS)		1 555	0.002	0.000	
(U) (U)	In FY 2007: Conducted Congressionally-directed effort for EBPS.		1.555	0.995	0.000	
Dra	R-1 Line	Item No. 18				
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\square		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUD(03 A	GET ACTIVITY Advanced Technology Developn	PE NUMBER AND TITLEPROJE0603112F Advanced Materials for4918Weapon SystemsDemo				ECT NUMBER AND TITLE Deployed Air Base onstrations				
(U) (U) (U)	B. Accomplishments/Planned Pro In FY 2008: Conduct Congressiona In FY 2009: Not Applicable.	o gram (\$ in Mil ally-directed eff	lions) ort for EBPS.				<u>F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Iodina In FY 2007: Conducted Congressio In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ted Ionic Antimi onally-directed e	icrobial Disposa effort for Iodina	ıl Masks. ted Ionic Antimi	crobial Disposa	l Masks.		2.600	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Strateg In FY 2007: Not Applicable. In FY 2008: Conduct Congressiona In FY 2009: Not Applicable.	gic Bio-fuels Suj ally-directed eff	oply Program. ort for Strategic	Bio-fuels Suppl	y Program.			0.000	1.589	0.000
(U) (U)	Total Cost							13.919	6.374	5.918
(U)	C. Other Program Funding Summ	<u>nary (\$ in Millio</u>	<u>ons)</u>							
		<u>FY 2007</u> <u>Actual</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	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
(U) (U) (U)	Related Activities: PE 0602102F, Materials. PE 0603287F, Physical Security Equipment.									
(U)	PE 0604617F, Agile Combat Support.									
(U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.									
(U)	D. Acquisition Strategy Not Applicable.									
Proj	ect 4918			R-1 Line Page	Item No. 18 -15 of 17 293				Exhibit R-2a	(PE 0603112F)

	Ex	hibit R-2a, I	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 03 A	ET ACTIVITY dvanced Technology Development	(ATD)		F	PE NUMBER AND 0603112F Adv Neapon Syste	o TITLE vanced Mater ems	ials for	PROJECT NUM 77SP Advan	IBER AND TITLE I CED Space M a	aterials
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
77SP	Advanced Space Materials	5.116	4.362	3.212	3.329	3.377	3.652	3.620	Continuing	TBD
	Quantity of RDT&E Articles		0	0		0				
Note:	In FY 2007, Project 7/SP, Advanced Sp lar to more offectively manage and provid	ace Materials, ef	forts transfer f	rom PE 06035	00F, Multidiscij	plinary Space	lechnology, P	roject 5032, Ad	Ivanced Space N	laterials,
	This project develops and demonstrates me scaled up to the appropriate level to demo developed and demonstrated to validate ex- engineering and system design decisions. sensors from a variety of laser threats. Re- current and future space systems.	naterials and proc onstrate materials xpected material Laser hardened educing risk in m	essing technol capability in t s characteristic materials techno aterials techno	ogies for trans he relative env s. Critical data nologies are de logy improves	ition into Air Fo ironment. Sub- a on both structu eveloped, demon the affordabilit	orce space syste scale compone ural and nonstr nstrated, and tra y, reliability, s	ems. Material ents and nonstr uctural materi ansitioned for urvivability, a	s and processes uctural materia als is developed the broadband j nd operational j	s development is al components and and provided f protection of spa performance of	s re Sor ace
(U) (U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and demon revolutionary improvements in the perfor In FY 2007: Developed advanced mater protection systems for leading edge appl Investigated combinations of candidate r foams, aerogels, heat pipes, and phase ch advanced ceramic materials and processi multicycle applications in an oxidizing e rocket engine components and validate p In FY 2008: Refine developed materials that provide solutions for cost-effective s high temperature composites on integrate component fabrication and scale-up of d In FY 2009: Utilizing newly developed for high temperature testing. Develop a ceramic, metallic, and carbon-carbon the	a (\$ in Millions) istrate advanced rmance of air-bra- ials approaches to ications on high- naterials, includi- nange materials, ing technologies nvironment. De performance in se formulations an scale-up, fabricate ed cryogenic tan- esign and process materials approa- sub-component of termal protection	materials and p eathing and roc to provide dural speed, reusable ng organic man for managemen for load bearin veloped rocket caled component d approaches f ion, and integr ks and hyperso s methodologie ches, fabricate cryogenic tank	processing tech sket-based aero ble, maintaina e launch, and f trix composites nt of thermal and g structures de propulsion maint demonstration for thermal pro- ation technique nic structures, es. thermal protect article and dem-	anologies to enai ospace vehicles ble high-temper uture reentry ve s, ceramics, met nd structural loa esigned for high aterials for liqui- ons. tection systems es. Validate per demonstrating l ction system sub nonstrate the in	ble and weapons. rature chicle concepts tals, carbon ads. Developed -temperature, d and solid and aeroshells rformance of low cost p-components tegration of	<u>F</u>	<u>Y 2007</u> 5.116	<u>FY 2008</u> 2.016	<u>FY 2009</u> 1.496
(U)	MAJOR THRUST: Develop and demon	strate advanced	materials techr	ologies that er	nhance hardenin	g for space		0.000	2.346	1.716
Proie	act 77SP			R-1 Line Iter Page-16	m No. 18 of 17				Exhibit R-2a (PF 0603112F)
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	Exh	DATE	February	2008					
BUD 03 /	GET ACTIVITY Advanced Technology Development (A	ATD)		PE NUMBER AND TITLE 0603112F Advanced Materials for Weapon Systems			PROJECT NUMBER AND TITLE 77SP Advanced Space Materials		
(U) (U) (U) (U)	B. Accomplishments/Planned Program systems. Note: Efforts in this major thrus In FY 2007: Not Applicable. In FY 2008: Optimize and validate limite Analyze laser phenomenology for intrinsic electro-optical sensors. In FY 2009: Fabricate and demonstrate li- impact of inserting state-of-the-art filters a	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>					
(U)	Total Cost						5.116	4.362	3.212
(U) (U) (U)	C. Other Program Funding Summary (\$ <u>FY</u> <u>4</u> Not Applicable. D. Acquisition Strategy Not Applicable.	<u>in Millions</u>) <u>2007 FY 2008</u> <u>Actual Estimate</u>	FY 2009 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> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Dro	ingt 77SD		R-1 Line	Item No. 18				Exhibit D 00	
Più			rage	295				EXHIUIL R-28	

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PE NUMBER: 0603203F PE TITLE: Advanced Aerospace Sensors

	Exhib	DATE	February	2008						
BUDGET 03 Adv	BUDGET ACTIVITY 3 Advanced Technology Development (ATD)					PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors				
	Cost (\$ in Millions)	FY 2007 Actual	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	56.634	62.332	56.916	58.664	55.847	58.408	57.244	0.000	0.000
665A	Advanced Aerospace Sensors Technology	17.892	17.880	16.542	26.085	23.331	21.707	20.331	0.000	0.000
69DF	Target Attack and Recognition Technology	27.015	32.220	30.130	25.921	25.709	28.589	29.102	0.000	0.000
88SP	Advanced Space Sensors	11.727	12.232	10.244	6.658	6.807	8.112	7.811	0.000	0.000

Note: In FY 2007, Project 88SP, Advanced Space Sensors, efforts were 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. Funds for the FY 2008 Congressionally-directed Moving Target Strike in the amount of \$1.6 million are in the process of being moved from PE 0603203F, Advanced Aerospace Sensors, to PE 0603601F, Conventional Weapons Technology, for execution.

(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 sensors, radar sensors and electronic counter-countermeasures, and components and algorithms. The second project develops and demonstrates radio frequency and electro-optical sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets obscured by natural or man-made means. The third project develops and demonstrates space sensor technologies including radio-frequency sensors; intelligence, surveillance, and reconnaissance sensors; electro-optical sensors; laser warning sensors; targeting and attack radar sensors; and electronic counter-countermeasures and communications. Together, the projects in this program develop the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Note: In FY 2008, Congress added \$3.2 million for TACNODES and \$4.0 million for Active Unmanned Air Vehicle (UAV) Phenomenology (AUP) & ART Technology Transition. 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 Budget Item Justification					
BUDGET	T ACTIVITY vanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sens	ors	ar y 2000			
(U) <u>B</u>	B. Program Change Summary (\$ in Millions)						
		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U) P	revious President's Budget	58.228	55.549	52.840			
(U) C	Current PBR/President's Budget	56.634	62.332	56.916			
(U) T	otal Adjustments	-1.594	6.783				
(U) C	Congressional Program Reductions		-0.007				
C	Congressional Rescissions		-0.410				
C	Congressional Increases		8.800				
R	Reprogrammings	-0.301	-1.600				
S	BIR/STTR Transfer	-1.293					
(U) <u>S</u>	ignificant Program Changes:						
Ir	n FY 2007, Project 88SP, Advanced Space Sensors, efforts transferred	d from PE 0603500F, Multidisciplinary Advanced Develop	ment Space Technology, Pre	oject 5034,			
A	dvanced Space Sensors, in order to more effectively manage and pro	wide oversight of the efforts.	-				
C	2. Performance Metrics						
U	Jnder Development.						

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	Ex	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDGE [®] 03 Adv	T ACTIVITY vanced Technology Development	(ATD)		P 0 5	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
665A	Advanced Aerospace Sensors Technology	17.892	17.880	16.542	26.085	23.331	21.707	20.331	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U) <u>A</u> Tl ap pl ta w	Mission Description and Budget Iten his project develops and demonstrates ac oplications in both manned and unmanned atforms with the capability to precisely rgets in adverse clutter and jamming env arfighting capabilities include the ability	n Justification erospace sensor a ed platforms, incl detect, track, and vironments. Proj v to detect concea	nd processing uding electro- target both air ect activities in aled targets in o	technologies fo optical sensors borne (conven nclude develop difficult backgr	or intelligence, and electronic tional and low a ing multi-funct round condition	surveillance, re counter-counte radar cross-sec ion radar and e IS.	econnaissance, rmeasures for tion) and grou lectronic comb	, target, and atta radars. It prov nd-based, high- pat technology.	ick radar ides aerospace value, time-criti Desired	ical
(U) <u>I</u> (U) M a l f f (U) I s s s	Accomplianments/Planned Program MAJOR THRUST: Develop integrated of and ground targets at ranges significantly ow-observable, or employ other means of unding to develop the three-dimensional ecognition of obscured and urban target n FY 2007: Continued development of ystem to detect, locate, and identify diff urveillance, and reconnaissance applical	a (\$ in <u>Millions</u>) electro-optical set of deception. No l laser detection a s, and the start of a multi-function icult targets in bo tions. Finalized	ensor technolog rently achieval te: Funding p and ranging sy the system en active/passive oth obscured a analysis of adv	gies to search, c ble, including ta eaks in FY 200 stem supporting gineering and i electro-optical nd urban enviro vanced passive	detect, locate, a argets that are c 8 due to the fin g automated/ass integration phas /infrared sensor onments for into and multi-funct	nd identify air amouflaged, al increment of sisted target se of that effort r demonstration elligence, tion active	<u>F</u>) f 1	3.946	<u>FY 2008</u> 6.725	<u>FY 2009</u> 4.212
(U) I (U) I (U) f	ensing methods to optimize detection ar inmanned aerial vehicle based sensor, in ensing methodologies which progress fr ncorporated long-wave infrared spectral lemonstrate target detection capability. mproved three-dimensional laser detection o support automated/assisted target reco n FY 2008: Begin airborne experiments lemonstration system to detect, locate, a ntelligence, surveillance, and reconnaiss hree-dimensional laser radar for high co alse alarm rate detection utilizing advan	ad identification cluding platform rom wide area se /polarimetric im. Finalized the des on and ranging s gnition of obscur s demonstrating r nd identify diffic cance application nfidence target ic ced change detect	of difficult targ integration pl arch to pinpoir ager into high ign and initiate ystem which h red and urban t nulti-function ult targets in b s. Perform fat dentification co ction and spatia	gets. Complete ans. Initiated on altitude sensor. e fabrication of as improved ra- targets. active/passive oth obscured a prication and te pupled with pas- al-spectral discr R-1 Line Iter	d design for my levelopment of and characteri Conducted fli, an engineering inge and resolut electro-optical/ nd urban enviro sting of high-re ssive spectral ir rimination tech n No. 19	ulti-mode coarse-to-fine zation. ght test to g model for an tion capability infrared onments for esolution, naging for low niques.				
Projec	t 665A			Page-3 c	of 20				Exhibit R-2a (I	PE 0603203F)

	Exhibit R-2a, RDT&E Projec	DA	DATE February 2008			
BUDC 03 A	GET ACTIVITY Avanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NU 665A Adva Technolog	JMBER AND TITLE Anced Aerospa JY	ice Sensors	
(U)	B. Accomplishments/Planned Program (\$ in Millions) Perform concept demonstration of multispectral/polarimetric focal plane arr target discrimination. Complete fabrication of improved three-dimensional conduct testing of the engineering model.	ay device for enhanced low contrast laser detection and ranging system and	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Continue airborne experiments demonstrating multi-function a demonstration system to detect, locate, and identify difficult targets in both intelligence, surveillance, and reconnaissance applications. Characterize en three-dimensional laser radar for high confidence target identification coupl false alarm rate detection utilizing advanced change detection and spatial-sp Complete development of multispectral/polarimetric focal plane array device discrimination, and design airborne sensor module for enhancement of multispectral of multispectral for enhancement of multispectral of multispectral for enhancement for enhancement of multispectral for enhancement for en	active/passive electro-optical/infrared obscured and urban environments for id-to-end performance of high-resolution, led with passive spectral imaging for low pectral discrimination techniques. the for enhanced low contrast target ti-function demonstration system.				
(U)			4.020	0.000	0.000	
(U)	MAJOR THRUST: Develop electro-optical sensor technologies to detect at targets for aerospace intelligence, surveillance, and reconnaissance application	nd locate camouflaged and concealed	4.928	0.000	0.000	
(U)	In FY 2007: Completed fabrication and testing of demonstration system for reflective and emissive spectral sensing capability for day and night operation and supported transition to acquisition center.	r high-altitude aircraft incorporating ons. Performed flight characterization				
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U)	MAJOR THRUST: Develop technologies to maximize positional accuracy techniques to improve offensive and defensive combat capabilities.	, timing accuracy, and exploitation	2.291	2.298	1.798	
(U)	In FY 2007: Demonstrated critical experiments using virtual flight test simulatechnologies for net centric warfare. Developed sensor phenomenology-base performed lab tests of multi-intelligence georegistration.	ulation to characterize assured reference sed georegistration for imagery and				
(U)	In FY 2008: Develop worldwide ultra-accurate positioning system technolo battlespace awareness, and persistent intelligence, surveillance, and reconna develop multi-sensor phenomenology-based georegistration for imagery and georegistration.	ogies to optimize time sensitive targeting, aissance capabilities. Continue to d perform lab tests of multi-intelligence				
(U)	In FY 2009: Demonstrate worldwide ultra-accurate positioning system tech targeting, battlespace awareness, and persistent intelligence, surveillance, an to develop multi-sensor phenomenology-based georegistration for imagery	nnologies to optimize time sensitive nd reconnaissance capabilities. Continue and perform lab tests of multi-intelligence				
Proj	ect 665A	R-1 Line Item No. 19 Page-4 of 20		Exhibit R-2a	(PE 0603203F)	

	Exhibit R-2a, RDT&E Proje	D/	February	/ 2008	
BUDC 03 A	GET ACTIVITY Idvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT N 665A Adv Technolo	ace Sensors	
(U)	B. Accomplishments/Planned Program (\$ in Millions) georegistration.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop, test, evaluate, and demonstrate lightweight, sensors to detect, track, and target high-value, time-critical targets that are concealment and enable persistent intelligence, surveillance, and reconnaise Develop and validate long-range intelligence, surveillance, and reconnaises for the detection and track of advanced air and ground targets. Advanced t low radar cross section, concealment capabilities, or electronic counter-core emphasis in this thrust in FY 2008 and FY 2009 is due to the increased for	low power, compact radio-frequency difficult to detect through either stealth or ssance from an unmanned aerial vehicle. sance sensor technologies and techniques target characteristics include targets with untermeasures. Note: The growing cus on multi-intelligence radio-frequency	3.886	4.748	9.765
(U)	systems. In FY 2007: Continued demonstration of the radio-frequency sensors of a radio-frequency sensor suite for unmanned aerial vehicles with severe size single platform persistent intelligence, surveillance, and reconnaissance ca systems architecture. Developed highly integrated receiver-aperture techn greatly reduced size, weight, and power. Continued experiments with the design for an airborne multi-intelligence experiment. Continued radar sys transition of developed enabling technologies and concepts to weapon syst reconnaissance assets. Developed program for threat analysis/mitigation of sensing	an integrated electro-optical/ e, weight, and power constraints, to enable apabilities compatible with a system of hologies for improved functionality and ground test bed providing input into a stems engineering support fostering the tems and intelligence, surveillance, and of passive multistatic, multi-intelligence			
(U)	In FY 2008: Continue demonstration of the radio-frequency sensors of an sensor suite (for unmanned aerial vehicles with severe size, weight, and popersistent intelligence, surveillance, and reconnaissance capabilities comparchitecture. Continue experiments with the ground test bed providing inp for an airborne multi-intelligence experiment. Continue radar systems eng developed enabling technologies and concepts to weapon systems and inter assets. Initiate a radar system analysis for improved air and ground target dual band radar.	a integrated electro-optical/radio-frequency ower constraints), to enable single platform atible with a system of systems out into the required operation and controls gineering support fostering the transition of elligence, surveillance, and reconnaissance detection and tracking using cross-cued,			
(U)	In FY 2009: Continue demonstration of the radio-frequency sensors of an sensor suite for unmanned aerial vehicles with severe size, weight, and popersistent intelligence, surveillance, and reconnaissance capabilities comparchitecture. Enhance the ground test bed with the inclusion of electro-optical sectors.	a integrated electro-optical/radio-frequency wer constraints, to enable single platform atible with a system of systems tical sensing modes, and provide input into			
Proj	ect 665A	R-1 Line Item No. 19 Page-5 of 20		Exhibit R-2a	(PE 0603203F)

Exhibit R-2a, RDT&E Project Justification	DA	DATE February 2008			
BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603203F Advanced Aerospace Sensors	PROJECT N 665A Adv Technolog	PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology			
(U) B. Accomplishments/Planned Program (\$ in Millions) the required design for an integrated electro-optical/radio-frequency sensor suite, including required data processing and exploitation. Continue sensor systems engineering support fostering the transition of developed enabling technologies and concepts to weapon systems and intelligence, surveillance, and reconnaissance assets. Continue experiments with the ground test bed providing input into a design for an airborne multi-intelligence experiment. Continue systems analysis for improved air and ground target detection and tracking using cross-cued, dual-band radar coupled with electronic support sensors.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
 (U) (U) MAJOR THRUST: Develop weapons guidance-quality track radar performance in advanced jamming environments. Develop and demonstrate advanced radar signal processing techniques to mitigate clutter and jamming interference and improve detection and tracking of difficult targets in hostile environments. (U) In FY 2007: Demonstrated and evaluated novel space-time adaptive processing techniques that are robust to heterogeneous data. Demonstrated and evaluated multi sensor waveform transmission and signal processing. 	0.849	0.930	0.767		
 (U) In FY 2008: Demonstrate and evaluate multi-sensor waveform transmission and signal processing techniques on selected advanced computing architectures. Implement novel space-time adaptive processing techniques that are robust to heterogeneous data. Implement tactical sensor network operations on the developed advanced computer architectures used for algorithm/waveform analysis 					
 (U) In FY 2009: Demonstrate the surveillance performance of homogeneous sensor networks and newly developed adaptive processing algorithms and waveforms in heterogeneous conditions, including clutter and jamming interference. 					
 (U) (U) CONGRESSIONAL ADD: Precision Image Tracking and Registration Program. (U) In FY 2007: Conducted Congressionally-directed effort for the Precision Image and Tracking Registration Program. (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 	0.996	0.000	0.000		
 (U) (U) CONGRESSIONAL ADD: Tactical Air Communication Nodes (TACNODES). (U) In FY 2007: Conducted Congressionally-directed effort for TACNODES. (U) In FY 2008: Conduct Congressionally-directed effort for TACNODES. (U) In FY 2009: Not Applicable. (U) 	0.996	3.179	0.000		
Project 665A R-1 Line Item No. 19 Project 665A Page-6 of 20		Exhibit R-2a	(PE 0603203F)		

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD 03 /	GET ACTIVITY Advanced Technology Developi	ment (ATD)			PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors			PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology		
(U) (U)	B. Accomplishments/Planned Pr Total Cost	ogram (\$ in Mil	lions)				F	<u>Y 2007</u> 17.892	<u>FY 2008</u> 17.880	<u>FY 2009</u> 16.542
(U)	C. Other Program Funding Sumr	<u>nary (\$ in Milli</u>	<u>ons)</u>							
		FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	FY 2012	FY 2013	Cost to	Total Cost
		<u>Actual</u>	Estimate	Estimate	Estimate	Estimate	Estimate	<u>Estimate</u>	<u>Complete</u>	<u>10tal Cost</u>
(U)	Related Activities:									
(U)	PE 0602204F, Aerospace									
an	Sensors.									
(U)	PE 0603205F, Flight Vehicle									
an	PE 0603707E Weather Systems									
(0)	Advanced Development									
an	PE 0603500F.									
(0)	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									
an	Precision Attack.									
(0)	PE 0003270F, Electronic									
an	A Memorandum of Agreement									
(0)	has been established between									
	Air Force Research Laboratory									
	and Defense Advanced Research									
	Projects Agency to jointly									
	develop the technology required									
	to detect high-value, time-critical									
	targets in a variety of									
				R-1 Line	e Item No. 19					
Pro	DJECT 665A			Pag	303				Exhibit R-2a	PE 0603203F)
					303					

Exhibit R-2a, RDT&	February 2008	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 665A Advanced Aerospace Sensors Technology
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> environments. (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.		
Project 665A	R-1 Line Item No. 19 Page-8 of 20	Exhibit R-2a (PE 0603203F)

	E	xhibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDGE 03 Ad	T ACTIVITY Ivanced Technology Development	: (ATD)		P 0 5	PE NUMBER AND 1603203F Adv Sensors	TITLE /anced Aeros	space	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognit Technology		ecognition
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
69DF	Target Attack and Recognition Technology	27.015	32.220	30.130	25.921	25.709	28.589	29.102	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
s h id t e n e s ii ii a	upport theater missile defense efforts in ostile fire. This project also develops and dentification of airborne and ground-base actical air-to-air and air-to-surface weap nvironments. Model-based vision algor naturing these technologies in partnershi fforts in surveillance and attack. Fire co- ignificant advancements in operational of n individual Major Thrusts in this project re created as outgrowths of other work i	surveillance and a nd demonstrates ta ed, high-value, the on systems so the rithms and target s ip with the Defension trol and recognic capabilities largely et decrease in FY 2 n the project for t	attack. These arget identifica me-critical targ y are able to op- signature devel se Advanced R tion technolog y through softw 2008 and FY 2 petter managen	fire control tecl tion and recog gets at longer ra opment technic esearch Projec ies developed a vare improvem 009 as 1., tech- nent and oversi	hnologies will p nition technologies than are c eather condition ques are the key ts Agency, and and demonstrat- ents readily tra nology is transi- ght.	provide force m gies for positiv currently possib as, during day o y to target ident evaluating the ed in this proje nsitionable to r	nultiplication a e, high confide ele. The goal i or night, and in ification and r techniques to ct are high lev new and existin tional platform	nd reduce warfi ence cueing, rec s to apply these high-threat, mu recognition. Thi support theater n erage efforts, pr ng weapon syste ns, and 2., sever	ghter exposure ognition, and technologies to altiple target s project is missile defense oviding for ems. Note: Fur al Major Thrus	to o nding ts
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and test ar stationary ground targets for use in strik in FY 2009 is due to the transition of the In FY 2007: Continued multi-spiral dev and reconnaissance platforms. Refined specific product development roadmaps	m (\$ in Millions) n automatic target e and reconnaissa e technology to the velopment of a race this capability for b. Provided transit	recognition sy ince platforms. e warfighter. lar based air-to integration in tion plans of th	rstem for tracki Note: The re- p-ground movin to candidate ra- e moving targe	ing and identify duced emphasis ng target algorit dar systems and et algorithm tec	ving moving and s in this thrust thm for tactical d platform hnology to	<u>F`</u> d	<u>¥ 2007</u> 4.540	<u>FY 2008</u> 5.212	<u>FY 2009</u> 0.332
(U)	operational strike and reconnaissance pl In FY 2008: Perform a real-time labora for tactical and reconnaissance platform would be integrated into candidate radar technology to operational strike and reco	atforms. tory demonstrations. Assess perform r systems. Provid onnaissance platfo	on of a radar ba nance against s e support to th prms as necess	used air-to-grou scenarios of int e transition of t ary.	ind moving targ erest to the war the moving targ	get algorithm fighter as get algorithm				
				R-1 Line Iter	n No. 19					
Projec				Page-9 0	DT 20				Exhidit R-2a (I	PE 0603203F)

	Exhibit R-2a, RDT&E Project Ju	DA	DATE February 2008			
BUDC 03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology			
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Continue providing support to the transition of the moving target al strike and reconnaissance platforms.	gorithm technology to operational	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U)	MAJOR THRUST: Develop and assess multi-sensor automatic target recognition reconnaissance, strike, and weapon systems. In FY 2007: Continued to assess the performance of Air Force and the Defense a multi-sensor automatic target recognition fusion algorithms using the Air Force a evaluation facility for application to intelligence, surveillance, reconnaissance, st Continued characterizing both single and multiple sensor contributions from rada hyperspectral imaging) sensors with automated exploitation. Collected, processes research-and-development sensor data for automated exploitation technology development and assessment with environment. Completed development of synthetic data generation capability to development, and operational data sets. Augmented the Department of Defense research-and-development sensor data with multi-sensor imagery and tracking date exercises. Continued to show impact of automated multi-sensor automatic target terms of timeline reduction for time-critical targeting to image analysts and decise Operations Centers. Initiated modeling of existing and emergent sensor systems exploitation technologies in simulated operational environments. Initiated assess identification approaches for multiple sensor types. Initiated evaluation of technologies in stability, and security operations.	n for intelligence, surveillance, Advanced Research Projects Agency automatic target recognition test and rike, and weapon systems. ar and electro-optical (including d, archived, and distributed velopment and assessment. collaborative computing augment collected research, wide repository of the collected at warfighter-sponsored recognition and fusion capability in ion-makers in the experimental Air for assessing automated sment of moving target tracking and ology enhancements for	4.813	3.889	2.141	
(U) (U)	In FY 2008: Begin spiral development and assessment of multi-sensor automatic algorithms. Assessment of technology supporting intelligence, surveillance, reco systems will occur in the Air Force automatic target recognition test and evaluati development and validation of synthetic data generation capability critically need development, and operational data sets. Critical examination of target, scene and independence and interdependence of features to support development of an opti capability. Enhance the Air Force automatic target recognition test and evaluation to support enhanced automatic target recognition fusion capabilities. In FY 2009: Continue spiral development and assessment of multi-sensor automatic algorithms. Continued assessment of technology supporting intelligence, surveil	c target recognition fusion onnaissance, strike, and weapon on facility. Continue spiral led to augment collected research, I scenario data to determine mum data fusion exploitation on facility and data sets as required atic target recognition fusion lance, reconnaissance, strike, and				
Proj	ect 69DF Pa	ne Item No. 19 ge-10 of 20		Exhibit R-2a	(PE 0603203F)	

Exhibit R-2a, RDT&E Project Justification	DATE	DATE February 2008				
BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603203F Advanced Aeros Sensors	PROJECT NUMBER 69DF Target At Technology	R AND TITLE				
(U) B. Accomplishments/Planned Program (\$ in Millions) weapon systems using the Air Force automatic target recognition test and evaluation facility. Continue spiral development and validation of synthetic data generation capability critically needed to augment collected research, development, and operational data sets. Develop automatic target recognition fusion sensor data exploitation capability utilizing analysis and experimentation of data independence and interdependence of features to support development of an optimum data fusion exploitation capability. Enhance the Air Force automatic target recognition test and evaluation facility and data sets as required to support enhanced automatic target recognition fusion capabilities. Determine technology shortfalls and develop automatic target recognition fusion technologies to overcome these shortfalls.	<u>FY 2007</u> <u>F</u>	<u>Y 2008 FY 2009</u>				
(U)						
(U) MAJOR THRUST: Develop and demonstrate a moderate-confidence automatic target recognition and advanced	8.370	8.053 6.887				
 (U) In FY 2007: Further developed 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. Furthered the technology demonstration effort of promising near-term, multi-sensor technologies and fusion processing techniques. Continued critical experiments of advanced multi-sensor, multi-platform technologies and fusion processing techniques for strike and intelligence, surveillance, and reconnaissance assets. Further characterized studies of advanced stationary and moving target multi-sensor data to determine utility for automatic target recognition, automatic target cueing, and combat identification. Further refined tool development to support sensor system, sensor management, and system performance analyses. Continued advanced multi-sensor data collections on stationary and moving targets. (U) 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 three-dimensional laser-detection-and-ranging automatic target recognition algorithm designed to achieve high confidence identification against targets in various degrees of clutter. Develop and evaluate an initial design of a laser vibrometry algorithm that provide the ability to determine target state (for example, engine on/off) and provide starget cue prioritizations and look geometry optimization for three-dimensional laser-detection-and-ranging and laser vibrometry senso	ſ					
R-1 Line Item No. 19						
Project 69DF Page-11 of 20		Exhibit R-2a (PE 0603203F)				

	Exhibit R-2a, RDT&E Project Just	stification	DATE February 2008				
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT N 69DF Tar Technolo	E Recognition			
(U)	B. Accomplishments/Planned Program (\$ in Millions) detection that were previously evaluated. Incorporate improvements in the initial laser-detection-and-ranging automatic target recognition algorithms that were previous improvements in the initial design of the laser vibrometry algorithms that were previous improvements in the initial design of the sensor management suite that were previous improvements in the initial set of laser sensor exploitation tools that were previous target recognition evaluation test facility and data sets as necessary to support program.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U)	MAJOR THRUST: Develop and demonstrate an automatic target recognition cap georegistration techniques and innovative change detection algorithms.	bility integrated with advanced	5.287	2.616	1.386		
(U) (U)	In FY 2007: Continued to utilize the advanced recognition capability test bed to in targeting capability to support the transition to the warfighter of technology produce and improve ability to dynamically track time-critical targets. Continued development multi-sensor management and data exploitation system supporting an all-weather transition unmanned aerial vehicles. Initiated design and conduct concept demonst identification sensor and exploitation capability. Initiated the development of an autilizes advanced radar features to fingerprint and associate vehicle observations a sensors to maintain continuous track through difficult terrain and in dense traffic. In FY 2008: Continue spiral assessment and development of automatic target recognistration, and change-detection technology. Assess technology supporting the Air Force automatic target recognition test and evaluation facility. Continue spiral	tegrate and upgrade time-critical ets that detect concealed targets nent of an autonomous nission for tactical platforms, tration of a concealed target dvanced tracking capability that nd integrates multiple radar gnition, automatic target cueing, time critical targeting systems in piral development and validation					
	of synthetic data generation capabilities critically needed to augment collected rese operational data sets. Interim demonstration and evaluation of concealed target id exploitation technologies. Interim demonstration and evaluation of advanced track maintenance technology in a militarily significant scenario. Enhance the Air Force and evaluation facility and data sets as required to support time-critical targeting c						
(U)	In FY 2009: Determine need to continue spiral assessment and development of au automatic target cueing, geo-registration, and change detection technology. Continue supporting time critical targeting systems in the Air Force automatic target recogn Continue spiral development and validation of synthetic data generation capability collected research, development, and operational data sets. Demonstrate time-critic tracking and multi-sensor track maintenance capabilities. Enhance the Air Force a	tomatic target recognition, nue assessment of technology tion test and evaluation facility. critically needed to augment cal targeting, advanced target utomatic target recognition test					
Pro	ject 69DF R-1 Lin Pag	e Item No. 19 e-12 of 20		Exhibit R-2a	(PE 0603203F)		
		308					

	Exhibit R-2a, RDT&E Project Justific	DATE February 2008					
BUD(03 A	GET ACTIVITY PE dvanced Technology Development (ATD) 06 Se	NUMBER AND TITLE 03203F Advanced Aerospace ensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology				
(U)	B. Accomplishments/Planned Program (\$ in Millions) and evaluation facility and data sets as required to support enhanced time-critical targeti technology shortfalls and develop emerging time-critical targeting and advanced target to overcome these shortfalls.	ng capabilities. Determine racking technologies to	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
an							
(U)	MAJOR THRUST: Develop an "identify friend, foe or neutral" air-to-ground capability non-cooperative identification techniques.	using cooperative and	2.610	2.646	2.523		
(U)	In FY 2007: Finalized design studies and initiate critical experiments to verify improve capabilities resulting from ground target database enhancements, identification algorithm advanced radio-frequency tags. Refined advanced identification algorithms and laborate sensor data to measure improved confidence and reliability of target identification. Fina design and conducted simulation testing to confirm improved pilot and system operator friendly identification confirmations, and performed initial interoperability assessments. to allow automatic screening of large volumes of intelligence, surveillance, and reconnatechnology for wide area detection, tracking, and identification against difficult, asymm Developed and integrated emerging technologies to enable small unmanned aerial vehic infrared sensors to provide persistent intelligence, surveillance, and reconnaissance.	d ground target identification n enhancements, and bry test with operational lized radio-frequency tag situation awareness, verify Improved exploitation tools issance imagery. Developed etric targets at long range. les with electro-optical and					
(U)	In FY 2008: Integrate and demonstrate improved ground target identification capabilitied databases, identification algorithm advancements and radio-frequency tags in a laborato maturity of technology via a combination of exercises and scientific analysis by the Air recognition evaluation test facility. Initiate spiral assessment and development of an "id air-to-ground capability, enhancing test facilities and target databases as necessary. Plan support.	es through enhanced target ry environment. Assess Force automatic target entify friend, foe or neutral" n operational exercise					
(U)	In FY 2009: Continue to integrate and demonstrate improved ground target identification enhanced target databases, identification algorithm advancements and radio-frequency t environment. Assess performance of technology to support warfighter integration with Continue refinement of identification algorithms and target databases as necessary to su- technology.	on capabilities through ags in an operational operational systems. pport transition of					
an	termology.						
(U)	MAJOR THRUST: Develop wide angle, continuous staring, multi-sensor/multi-wavele exploitation technology that provides detection, tracking and identification of numerous significance over very large ground areas at sensor data update rates. Note: This work i	ngth sensing, and automated objects of possible military s an outgrowth of other work	0.000	5.830	6.000		
	R-1 Line Item	No. 19					
Pro	Page-13 0	120		Exhibit R-2a	(PE 0603203F)		

	Exhibit R-2a, RDT&E Proj	DATE February 2008				
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT N 69DF Tar Technolo	Recognition		
(U)	B. Accomplishments/Planned Program (\$ in Millions) within this project.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Design and breadboard the individual waveband sensors rec automated exploitation capability. Collect data required to support the de automated exploitation of the wide-angle, continuous-staring capability. through scientific analyses conducted the Air Force automatic target reco	quired to support the persistent staring and evelopment, testing and validation of the Assess the maturity of the technology ponition test and evaluation facility				
(U)	In FY 2009: Design and develop engineering model of the multi-sensor, continuously-staring capability building upon the technologies developed Integrate and demonstrate the wide-angle, continuously-staring compone technology via a combination of exercises and scientific analyses in the <i>A</i> and evaluation facility. Initiate spiral development of wide angle, continu phenomenological modeling, target and scenario databases necessary to s SAF Interest Item to develop Gotcha Radar, Night Stare, and related electradar staring sensor technologies and algorithms.	multi-wavelength wide-angle d during the individual component stage. nt technologies. Assess the maturity of the Air Force automatic target recognition test uous staring exploitation algorithms, support transition to the warfighter. Initiate tro-optical, infrared, and synthetic aperture				
(U) (U)	MAJOR THRUST: Develop an advanced suite of sensors with automatic tracking, all working in concert to provide a high confidence identificatio outgrowth of other work within this project.	c target recognition, fusion, and target on capability. Note: This work is an	0.000	0.000	10.861	
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable.					
(U)	In FY 2009: Design and test an advanced aimpoint tracking capability. I recognition capability using electro-optical sensor data. Build upon prev- target recognition capability to develop a high-confidence exploitation of advanced capability to fuse information and exploitation results from mu confidence identification development of algorithm phenomenological m necessary to support technology development. Assess maturity of technology Force automatic target recognition test and evaluation facility and other s	Develop and test automatic target ious synthetic aperture radar automatic synthetic aperture radar data. Develop an ltiple sensors. Initiate spiral high iodeling, target and scenario databases ology during the spiral process via the Air sensor test facilities.				
(U) (U)	CONGRESSIONAL ADD: National Operational Signature Production a Identification Signature Center)	and Research Capability (Combat	1.395	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for National Ope	erational Signature Production and Research				
Proj	ject 69DF	R-1 Line Item No. 19 Page-14 of 20		Exhibit R-2a	(PE 0603203F)	

		Exhibit R-	2a, RDT&E	Project Jus	tification			DA	TE February	/ 2008
BUD(03 A	GET ACTIVITY Advanced Technology Developn	nent (ATD)			PE NUMBER A 0603203F A Sensors	ND TITLE	PROJECT NU 69DF Targ Technolog	CT NUMBER AND TITLE Target Attack and Recognition nology		
(U)	B. Accomplishments/Planned Pro	<u>gram (\$ in Mil</u>	<u>lions)</u>					<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
	Capability (Combat Identification S	Signature Center	.).							
(U)	In FY 2008: Not Applicable.									
(U)	In FY 2009: Not Applicable.									
(U)										
(U)	CONGRESSIONAL ADD: Active Transition.	Unmanned Air	Vehicle (UAV)) Phenomenolog	y (AUP) & ART	Technology		0.000	3.974	0.000
(U)	In FY 2007: Not Applicable.									
(U)	In FY 2008: Conduct Congressiona	ally-directed eff	ort for Active U	Inmanned Air Ve	ehicle (UAV) Pl	nenomenology				
	(AUP) & ART Technology Transit	ion.								
(U)	In FY 2009: Not Applicable.									
(U)										
(U)	Total Cost							27.015	32.220	30.130
(U)	C. Other Program Funding Summ	<u>ary (\$ in Millio</u>	ons)							
		FY 2007	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	FY 2012	<u>FY 2013</u>	<u>Cost to</u>	Total Cost
		<u>Actual</u>	Estimate	<u>Estimate</u>	Estimate	Estimate	Estimate	Estimate	e <u>Complete</u>	<u>10tai Cost</u>
(U)	Related Activities:									
(U)	PE 0602204F, Aerospace									
	Sensors.									
(U)	PE 0603253F, Advanced Sensor									
	Integration.									
(U)	PE 0603500F,									
	Multi-Disciplinary Advanced									
	Space Technology.									
(U)	PE 0603762E, Sensor and									
	Guidance Technology.									
(U)	PE 0603270F, Electronic									
	Combat Technology.									
(\mathbf{U})	I neater Missile Defense System									
	Program UIIIce.									
(0)	Low Allitude Night Largeting									
	and initiated Navigation									
Dro	iect 69DE			R-1 Line	Item No. 19				Evhibit P 20	(PE 0603203E)
F10				raye	211					

Exhibit R-2a, RDT	Exhibit R-2a, RDT&E Project Justification							
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 69DF Target Attack and Recognition Technology						
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> (LANTIRN) System Program Office. (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. 	2612013							
Project 69DF	R-1 Line Item No. 19 Page-16 of 20	Exhibit R-2a (PE 0603203F)						

	Ext	hibit R-2a, F	RDT&E Pro	ject Justif	ication				DATE	February	2008
BUDG 03 Ac	ET ACTIVITY Ivanced Technology Development (ATD)		F	PE NUMBER AND 0603203F Adv Sensors	TITLE anced Aeros	space	PROJECT NUMBER AND TITLE 88SP Advanced Space Sensors			
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 20	013	Cost to	Total
	Cost (\$ in Minions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estim	nate	Complete	
88SP	Advanced Space Sensors	11.727	12.232	10.244	6.658	6.807	8.112	- -	7.811	0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0		0		
Note:	In FY 2007, efforts were transferred from	n PE 0603500F,	Multidisciplina	ary Advanced	Development S	pace Technolog	gy, Project 50.	34, Advar	nced Sp	pace Sensors, ir	n order to
more	effectively manage and provide oversight	of the efforts.									
	This project develops and demonstrates spate- electro-optical sensors; laser warning sensor nulti-function radar, laser, electronic comb he capability to precisely detect, track, and	ace sensor technors; targeting an bat, and electror d target air- and	ologies, includ d attack radar s ic counter-cou ground-based,	ling radio freq sensors; and el ntermeasures t high-value, tin	uency sensors; i lectronic counter technologies for me-critical targe	ntelligence, sur -countermeasu space applicat ts, while remai	rveillance, and ires and comm ions, this proje- ining invulner	l reconnai nunication ect provid able to ho	issance ns. By les spac ostile ar	sensors; developing ce platforms wi nd natural threa	th ts.
(U)	B. Accomplishments/Planned Program	(\$ in Millions)					FY	2007 X		FY 2008	FY 2009
(U)	MAJOR THRUST: Reduce technology r	isk for space se	nsor platform p	ayload compo	onents and explo	itation of		0.698		0.452	0.842
(U) (U) (U)	infrastructure integration. In FY 2007: Integrated space-sensor tech hardware in the loop and demonstrate syss In FY 2008: Develop approach to design implementation feasibility. Define payloa In FY 2009: Develop "plug-and-play" sat	nologies into a tem design feas responsive spac ad to bus satellit tellite critical ex	complete radar ibility. e payload capa e interface requerement, to in	payload simu abilities while uirements and cluding full si	lation test bed w retaining hardw standards. mulation.	with selected					
(U) (U)	MAJOR THRUST: Develop and demons positional accuracy, timing accuracy, and capabilities.	strate technologi exploitation tec	es to maximize hniques to imp	e global positio prove offensive	oning system jar e and defensive	n resistance, combat		1.079		1.289	2.200
(U)	In FY 2007: Developed space-based distr locate global positioning system threats. I networked clusters of unmanned aerial ve space-based platforms.	ributed position Developed mult hicles, intellige	, navigation, an i-ship virtual fi nce, surveilland	nd timing techn light test simu ce, and reconn	nologies to detect lation technolog aissance platfor	et, identify and y to assess ms, and					
(U)	In FY 2008: Demonstrate space-based dia and locate global positioning system threa assess networked clusters of unmanned as space-based platforms.	stributed position ats. Demonstrate erial vehicles, in	on, navigation, e multi-ship vi telligence, surv	and timing tec rtual flight test veillance, and	chnologies to det t simulation tech reconnaissance	ect, identify, mology to platforms, and					
(U)	In FY 2009: Design space-based distribu-	ted position, na	vigation, and ti	ming technolo	gies to achieve	optimal sensor					
Proje	ct 88SP			R-1 Line Itel Page-17	m No. 19 ′ of 20					Exhibit R-2a (F	PE 0603203F)

Exhibit R-2a, RDT&E Project Justification		DATE February 2008				
BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603203F Advanced Aerosp Sensors	PROJECT 88SP A	PROJECT NUMBER AND TITLE 88SP Advanced Space Sensors				
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> fusion for space situational awareness. Design multi-ship virtual flight test simulation technology to assess world-wide distributed position, navigation, and timing architectures for disparate platforms for space situational awareness.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
 (U) (U) MAJOR THRUST: Develop electro-optical sensor component technology to advance multiple space mission areas. Develop new sensor components, topologies and architectures for space. (U) In FY 2007: Fabricated advanced space environment phenomenology sensor components. (U) In FY 2008: Conduct experimental space flight of sensor components to test in space environment. Initiate data collection, testing and system evaluation with relevant space environment phenomenology. (U) In FY 2009: Complete experimental space flight of sensor components to test in space environment. Complete data collection, testing and system evaluation. Initiate lab-based integration testing with embedded satellite components. 	1.578	1.610	1.520			
 (U) MAJOR THRUST: Develop advanced laser communication component and sub-system technology to support a network-level topology for airborne intelligence, surveillance, and reconnaissance (U) In FY 2007: Began development of an integrated wideband radio-frequency/electro-optical communication terminal and shared-aperture antenna for evaluation and testing in an air-network layer. Continued development of technologies for radio-frequency/electro-optical shared apertures to service high-bandwidth communication needs. Continued testing applicability of shared apertures to maintaining air-network link connectivity under adverse weather conditions. Expanded flight demonstrations of radio-frequency, optical, and combined radio-frequency/optical communication terminal technologies for air-network layers. (U) In FY 2008: Continue development of an integrated wideband radio-frequency/electro-optical communication terminal and shared aperture antenna. Begin evaluation and testing of the integrated terminal and antenna in an air network layer. Begin maturation of technologies for integration into communication architecture. Continue flight demonstrations of radio-frequency/optical communication terminal technologies for air-network layer. (U) In FY 2009: Continue maturation of technologies for integration into airborne network architecture. Conduct ground and flight tests of laser communication system. Develop the advanced free space optical modem focusing on compact packaging for airborne terminal rack rack installations. Integrate optical terminal with radio-frequency communications terminal for intelligence, surveillance, and reconnaissance relay missions. Demonstrate hybrid free space optical/radio-frequency failsafe/failback operations in airborne tests. Note: this effort ends in FY09. 	5.000	6.349	5.000			
R-1 Line Item No. 19 Project 88SP Page-18 of 20		Exhibit R-2a	a (PE 0603203F)			

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATI	February	2008	
BUD(03 A	GET ACTIVITY Advanced Technology Develop	ment (ATD)			PE NUMBER AND TITLE PROJI 0603203F Advanced Aerospace 88SP Sensors				ECT NUMBER AND TITLE P Advanced Space Sensors		
(U)	B. Accomplishments/Planned Pr	ogram (\$ in Mil	lions)				F	<u>¥ 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Develop and operations over current reflector a network.	demonstrate a geo ntennas. Improve	odesic phased a operational ca	rray antenna to a pacity and efficie	chieve enhanced ency to support	d satellite satellite control		3.372	2.532	0.682	
(U)	In FY 2007: Analyzed system req antenna. Finalized radio-frequence performance characteristics. Com former array papels, and the anten	uirements and co y and mechanical pleted evaluation	mplete the design designs of the of the transmit	gn of the multi-b geodesic dome p /receive modules	beam geodesic de banels to demons s, the radiating e	ome phased arra strate critical lement, beam	y				
(U)	In FY 2008: Fabricate transmit/re phased array antenna dome sub-se In FY 2009: Fully characterize th	ceive modules, ra cetor to be used in e advanced technologi	the advanced to	ts, beam former echnology demo ator sub-sector a	array panels for nstration.	the geodesic	1				
(U)	satellites. Total Cost		ology demonstr			with operational	1	11.727	12.232	10.244	
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millic</u>	o <u>ns)</u>								
		<u>FY 2007</u> <u>Actual</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	Total Cost	
(U) (U)	Related Activities: PE 0602204F, Aerospace										
(U)	PE 0602500F, Multi-Disciplinary Space										
(U)	PE 0603500F, Multi-Disciplinary Advanced										
(U)	PE 0603270F, Electronic										
(U)	This project has been coordinated through the Reliance process to harmonize										
	efforts and eliminate duplication.										
Pro	ject 88SP			R-1 Line Page	Item No. 19 -19 of 20				Exhibit R-2a	(PE 0603203F)	
					315						

Exhibit R-2a, RDT&	Exhibit R-2a, RDT&E Project Justification					
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT NUMBER AND TITLE 88SP Advanced Space Sensors				
(U) <u>D. Acquisition Strategy</u>						
Not Applicable.						
Proiect 88SP	R-1 Line Item No. 19 Page-20 of 20	Exhibit R-2a (PE 0603203F)				
	316					
	UNCLASSIFIED					

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

	Exhib	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDGE 03 Ad	T ACTIVITY vanced Technology Development (ATD)		PE 0	E NUMBER AND	TITLE ospace Tech	nology Dev/D	Demo		
	Cost ([§] in Millions)	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	Complete	
	Total Program Element (PE) Cost	45.443	66.884	44.918	83.204	69.231	86.163	99.803	Continuing	TBD
486U	Advanced Aerospace Structures	7.188	2.384	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
4920	Flight Vehicle Tech Integration	35.569	64.500	44.918	83.204	69.231	86.163	99.803	Continuing	TBD
99SP	Advanced Structures Space Vehicles	2.686	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
Note: 63506 Off an for exe (U) <u>A</u> T a p S	In FY 2007, Project 6399SP, Advanced S 2, Advanced Structures for Space Vehicles d Landing Herk 1 Continuation in the amo ecution. A. Mission Description and Budget Item This program demonstrates advanced aeros and future aerospace vehicles. Aerospace vehicles. Aerospace vehicles. Aerospace vehicles. Topulsion, and weapons systems for demo mall Structures Efficient Tactical (BASSI This program is in the Budget Activity 3, 4 pgrades and/or new system developments	tructures for Sp s, order to effec ount of \$1.594 w Justification space vehicle technolo enstration in nea ET) unmanned a Advanced Techn that have milita	ace Vehicles, of tively manage vere moved int chnologies. Ac ogy integration r-realistic oper air vehicle, and nology Develo ary utility and a	efforts were trai and provide ov o PE 0603211F dvanced aerosp is accomplishe rational environ \$1.6 million fo pment, since it address warfigh	nsferred from F ersight of the e F, Aerospace Te ace structures a d through integ ments. Note: or Titanium Str develops and d tter needs.	PE 0603500F, M efforts. Funds f echnology Dev are demonstrate gration of vario In FY 2008, Co uctures Initiativ lemonstrates tec	Aultidisciplinar or the FY 2007 /Demo, from Pl ed to sustain and us technologies ongress added \$ /e. chnologies for e	y Advanced Sp ' Congressiona E 0401115F, C d enhance the c s to include avio 50.8 million for existing aerospa	ace Technolog lly-directed Sh -130 Airlift Sq capability of cu onics, advance Big Antennas ace vehicle sys	gy, Project lort Take luadron, rrent d
(U)	<u>B. Program Change Summary (\$ in Mil</u>	<u>lions)</u>					EV 2007		2000	FX 2 000
	Dravious Drasidant's Pudgat						<u>FY 2007</u> 26 286	<u>FY 2</u>	022	<u>FY 2009</u> 56 345
(0)	Current PBR/President's Budget						50.280 45.443	04	.922	30.343 44.918
	Fotal Adjustments						9 157	1	962	++.910
	Congressional Program Reductions						2.157	1	.902	
	Congressional Rescissions							-0	438	
	Congressional Increases							2	.400	
1	Reprogrammings						10.064	2		
	SBIR/STTR Transfer						-0.907			
ധ	Significant Program Changes:									
	(U) C. Performance Metrics Under Development									
				R-1 Line Item Page-1 d	n No. 20 of 8				Exhibit R-2 (PE 0603211F)
				317 UNCLASS	SIFIED					

	ExI	DATE	DATE February 2008									
BUDG 03 Ac	ET ACTIVITY dvanced Technology Development (ATD)			PE NUMBER AND 0603211F Aero Dev/Demo	TITLE DSpace Tech	nology	PROJECT NUMBER AND TITLE 486U Advanced Aerospace Structures				
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total		
40 (1)		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	TDD		
4860	Advanced Aerospace Structures	/.188	2.384	0.000	0.000	0.000	0.000	0.000	Continuing	IBD		
	Quantity of RDT&E Articles		0	0	0	0	0	0				
	This project develops and demonstrates aff capability of current and future aerospace v will lead to reduced operations and suppor replacement by allowing and certifying nev envelope and increase survivability in high the capability, and reduce the life cycle cos	fordable aerospa vehicles. Sustai t costs, and increase w designs under threat environn sts of fielded air	ce vehicle tech nment of the ex- eased operation reduced test re- nents. Demons craft.	nnologies to su xisting fleet th nal readiness. equirements. stration of the	astain the existin arough extended Analytical certif Development of se technologies v	g fleet, reduce operational ser fication will red capability enha will restore stru	the cost of airo vice life with duce the cost a ancing technol ctural integrit	craft ownership, innovative techn associated with o logies will expany y, extend structu	and enhance the nology application component nd the operation and life, enhance	ne ion nal ce		
(U) (U) (U) (U) (U) (U)	B. Accomplishments/Planned Program CONGRESSIONAL ADD: Design Manu In FY 2007: Conducted Congressionally- composite structure. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	(\$ in Millions) al for Titanium directed effort t	Honeycomb S o design manu	andwich Com al for titaniun	posite Structure. 1 honeycomb sar	ndwich	<u>F)</u>	<u>7 2007</u> 1.065	FY 2008 0.000	<u>FY 2009</u> 0.000		
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Wright Broth In FY 2007: Conducted Congressionally In FY 2008: Not Applicable. In FY 2009: Not Applicable.	hers Institute - C	apabilities Ana	alysis Phase 2 s planning sup	port.			1.647	0.000	0.000		
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: 3-D Woven/I In FY 2007: Conducted Congressionally In FY 2008: Not Applicable. In FY 2009: Not Applicable.	Braided Compos r-directed effort	sites. for 3-D woven	/braided comj	posites.			0.980	0.000	0.000		
(U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced A In FY 2007: Conducted Congressionally In FY 2008: Conduct Congressionally-di In FY 2009: Not Applicable.	erospace Titaniu -directed AATS rected AATS ef	um Structures (effort. fort.	(AATS) Initiat	tive.			0.980	1.589	0.000		
Proje	ect 486U			R-1 Line Ite Page-2	em No. 20 2 of 8				Exhibit R-2a (F	PE 0603211F)		
Proje	ect 486U			Page-2	2 of 8 8				Exhibit R-2a (F	PE 0603211		
		Exhibit R-	2a, RDT&E	Project Jus	stification			DA	February	2008		
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BUD(03 A	GET ACTIVITY Advanced Technology Developr	ment (ATD)			PE NUMBER A 0603211F A Dev/Demo	ND TITLE erospace Tec	hnology	PROJECT NU 486U Adva	IMBER AND TITLE	ce Structures		
(U)	B. Accomplishments/Planned Pro	ogram (\$ in Mil	<u>lions)</u>					<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Advar In FY 2007: Conducted Congress In FY 2008: Not Applicable. In FY 2009: Not Applicable.	nced Aluminum ionally-directed	Aerostructures A3I effort, last	(A3I) Initiative. funded by Cong	ress in FY 2005			1.258	0.000	0.000		
(U) (U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Large In FY 2007: Conducted Congressi In FY 2008: Not Applicable. In FY 2009: Not Applicable.	DNGRESSIONAL ADD: Large Scale Affordable Composite Structures. 1.2 FY 2007: Conducted Congressionally-directed effort for large-scale affordable composite structures. 1.2 FY 2008: Not Applicable. 1.2 FY 2009: Not Applicable. 1.2 DNGRESSIONAL ADD: Big Antennas Small Structures Efficient Tactical (BASSET) Unmanned Aireal Vehicles 0.0										
(U) (U) (U) (U)	 CONGRESSIONAL ADD: Big Antennas Small Structures Efficient Tactical (BASSET) Unmanned Aireal Vehicles. In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for big antennas small structures efficient tactical unmanned aireal vehicles. In FY 2009: Not Applicable 									0.000		
(U) (U)	Total Cost							7.188	2.384	0.000		
(U)	C. Other Program Funding Summ	<u>nary (\$ in Milli</u>	<u>ons)</u>									
(U) (U)	Related Activities: This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	FY 2007 Actual	<u>FY 2008</u> <u>Estimate</u>	<u>FY 2009</u> <u>Estimate</u>	<u>FY 2010</u> Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>		
(U)	D. Acquisition Strategy Not Applicable.			R-1 Line	e Item No. 20							
Pro	ject 486U			Pag	ge-3 of 8				Exhibit R-2a (PE 0603211F)		
				•								

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 03 Ac	ET ACTIVITY dvanced Technology Development (ATD)		P 0 C	PE NUMBER AND 1603211F Aero 1907/Demo	TITLE ospace Tech	nology	PROJECT NUM 4920 Flight \	BER AND TITLE /ehicle Tech I	ntegration
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4920	Flight Vehicle Tech Integration	35.569	64.500	44.918	83.204	69.231	86.163	99.803	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project integrates and demonstrates ad unmanned aerospace vehicles. System lev demonstration in a near-realistic operational operational aircraft. This program provide	dvanced flight v el integration br al environment. s proven aerosp	ehicle technolo ings together t Integration an ace vehicle tec	bgies that will i he aerospace w Id technology d hnologies for a	mprove the per ehicle technolo lemonstrations all-weather, day	formance and s gies along with reduce the risk /night operatio	supportability avionics, prop and time requins with improv	of existing and pulsion, and we ired to transitio ved performanc	future manned a capon systems fo n technologies i ce and affordabil	and or nto lity.
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop autonomous and unmanned air platforms.	(\$ in Millions) s flight controls	for safe flight	and cooperative	e operations bet	ween manned	<u>F</u> Y	<u>7 2007</u> 5.239	<u>FY 2008</u> 6.299	<u>FY 2009</u> 6.485
(U)	and unmanned air platforms. In FY 2007: Completed ground simulation and flight demonstration of key hardware and software systems for adaptive, fault tolerant, autonomous unmanned air vehicle airborne control. Initiated development of situational awareness and control technologies for automated air base ground operations for unmanned air vehicles									
(U)	In FY 2008: Further develop situational a operations for unmanned air vehicles. Init base ground operations for unmanned air	awareness and c tated electromag vehicles.	ontrol technolo gnetic threat to	ogies for autom lerant control s	nated air base gr systems technol	ound ogies for air				
(U)	In FY 2009: Conduct ground demonstrative vehicles operating in and around air bases vehicles in complex, low altitude environ for affordable cartification of autonomous	ions of situation 5. Develop and 6 ments. Conduct	al awareness a demonstrate co evaluation of	nd control tech ooperative team validation and	nologies for un ning of small un verification too	manned air manned air ls and process				
an	for anordable certification of autonomous	s uninanneu an	venicie inglit c	Solution soltware	Ξ.					
(U)	MAJOR THRUST/CONGRESSIONAL A improve the performance of manned and demonstration efforts related to the comp	ADD: Develop, unmanned platfo osite affordabili	simulate, and orms. In FY 2 ty initiative.	demonstrate in 2008, increased	tegrated techno l emphasis being	logies to g placed on	1	12.481	41.149	17.139
(U)	In FY 2007: Initiated development of a state for improved capabilities for high speed of STOL Herk 1.	imulation enviro operational conc	onment to enab epts. Conduct	ed Congressio	of network centr nally-directed e	ic technologies fforts for	5			
(U)	In FY 2008: Conduct flight demonstration tunnel testing of gust load alleviation and platforms. Complete integration of data s	n of extensive la body freedom f treams and anal	aminar flow or lutter suppress ysis tools; grap	n swept wing te ion of high alti phical user inte	est article. Com itude, long endu rfaces; database	plete wind rance e/model				
Proje	oct 4920			R-1 Line Iter Page-4	n No. 20 of 8				Exhibit R-2a (I	PE 0603211F)

	Exhibit R-2a, RDT&E Project Justif	Exhibit R-2a, RDT&E Project Justification February 2008					
BUD(03 A	GET ACTIVITY F dvanced Technology Development (ATD) C E	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT NI 4920 Fligh	JMBER AND TITLE It Vehicle Tech	Integration		
(U)	B. Accomplishments/Planned Program (\$ in Millions) updates; validation of model and selection criteria; and identification of model correcti integrate aircraft components that capitalize upon unitized advanced materials that are into an X-type cargo aircraft. Develop approaches that would reduce the tooling requi components. Begin flight demonstration efforts for an X-type cargo aircraft.	ion factors. Develop and lightweight and affordable red to fabricate aircraft	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Complete flight demonstration of extensive laminar flow on swept wing complete flight demonstration of an X-type aircraft comprised of advanced materials for smoothness, corrosion, and fatigue elimination. Continue development of a simulation evaluation of network centric technologies for improved capabilities for high speed op	test article. Conduct and for weight reduction, surface a environment to enable erational concepts.					
(U) (U)	MAJOR THRUST: Develop analytical certification methods and capability to reduce the certification of structural components resulting in reduced acquisition cost for new costs for future and legacy systems. Demonstrate reduced support costs for future syst advanced monitoring capabilities. Note: In FY 2008, the demonstration efforts real-ti health monitoring demonstration efforts suspended because of the need for additional a	the need for physical testing in systems and reduced support tems by incorporation of me diagnostic and prognostics Applied Research efforts.	8.614	0.000	0.000		
(U)	In FY 2007: Continued demonstration of improved sustainment technologies for exist aerospace vehicle structures to reduce operations and support costs and extend usable a demonstration of real-time diagnostic and prognostics health monitoring tools for them structures, and subsystems to enable rapid turn around and high temperature operations	ing aging aircraft and future structural lives. Continued mal protected systems, tanks, s.					
(U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U)	MAJOR THRUST: Develop aircraft structures that have embedded components, which separate components that were attached to the air platforms. Note: The FY 2008 and due to the demonstration efforts related to flight testing of large X band antenna ember airframe structure.	ch have previously been out year increase in funding is odded in a load bearing	6.170	14.003	13.160		
(U)	In FY 2007: Assessed results from flight demonstration of concepts with high multi-e embedded in load-bearing structure to increase antenna performance improvement and and volume. Continued demonstration of concepts for very large, low frequency anter load-bearing structure to enable new antenna capabilities and increased performance, w	lement antenna arrays l reduced vehicle weight, cost, nna arrays embedded in while reducing vehicle weight,					
(U)	In FY 2008: Complete structural demonstration of low band antenna structure. Asses	and refine development of					
Pro	ect 4920 R-1 Line Iter Page-5	m No. 20 of 8		Exhibit R-2a	(PE 0603211F)		

	Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	/ 2008
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)			PE NUMBER A 0603211F A Dev/Demo	ND TITLE erospace Tech	nology	PROJECT NUM 4920 Flight	IBER AND TITLE Vehicle Tech	Integration
(U)	B. Accomplishments/Planned Program (\$ in Mil multi-functional integrated structures to reduce cost Complete fabrication and flight test a large X band structure.	lions) t, weight, while electronically-s	improving perfo	ormance of futur array embedded	e air platforms. in a load-bearing]	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Complete and assess test results from scanned antenna array embedded in a load-bearing	the flight demo structure.	nstration of the l	large X band ele	ctronically				
(U) (U)	MAJOR THRUST: Develop adaptive structures to over a wide range of flight conditions and mission	provide in-fligl profiles.	ht modifications	offering improv	ed performance		3.065	3.049	8.134
(U)	In FY 2007: Further refined integrated thermal air attachments, seals, joining technologies, hot primar vehicle applications. Continued development and c aero elastic design concepts, adaptive structures, an range and long endurance air vehicle concepts	rame structures y structure, and lemonstration o d aerodynamic	including therm structural health f highly efficien flow control tec	al protection sy n monitoring for t wing concepts hnologies to ena	stems, high-speed integrating active ble viable long				
(U)	In FY 2008: Develop passive and active leading ed validate integration methodologies for component l demonstration of highly efficient wing concents int	lge cooling syst evel leading edge egrating active	ems for ultra, hig ge test articles.	gh-speed vehicle Complete develo	es. Develop and opment and				
(U)	In FY 2009: Demonstrate passive and active therm components. Assess results from demonstrations o design concepts and adaptive structures. Note: Th demonstration efforts related to integrated airframe applications.	al protection sy f advanced effic the FY 2008 and and structural	esterns for leadin cient wings conc out year increas health managem	g edge of high-s epts integrating e in funding is d ent for high spe	peed vehicle active aeroelastic ue to the ed vehicle				
(U) (U)	Total Cost						35.569	64.500	44.918
(U)	C. Other Program Funding Summary (\$ in Millio FY 2007 Actual	o <u>ns)</u> <u>FY 2008</u> 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>
(U) (U) (U)	Related Activities: PE 0602201F, Aerospace Vehicle Technologies. PE 0604015F, Next Generation Bomber.	Louinate				Listinue		Complete	
Pro	ect 4920		R-1 Line Pag	e Item No. 20 ge-6 of 8				Exhibit R-2a	(PE 0603211F)
				322					

Exhibit R-2a, RDT	&E Project Justification	DATE February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603211F Aerospace Technology Dev/Demo	PROJECT NUMBER AND TITLE 4920 Flight Vehicle Tech Integration
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>		
 (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication. 		
(U) <u>D. Acquisition Strategy</u> Not Applicable.		
Project 4920	R-1 Line Item No. 20 Page-7 of 8	Exhibit R-2a (PE 0603211F)

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	fication			DATE	February	2008
BUDGE 03 Ad	T ACTIVITY Ivanced Technology Development (ATD)		ł	PE NUMBER AND 0603211F Aer Dev/Demo	o TITLE ospace Tech	nology	PROJECT NUME 99SP Advanc Vehicles	BER AND TITLE	es Space
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total
99SP	Advanced Structures Space Vehicles	2.686	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	continuing	122
Projec were the constraint of	t 635062, Advanced Structures for Space cansferred into Project 4920 within this PE A. Mission Description and Budget Item This project identifies, develops, and demo perability, responsiveness, and cost-effect	Vehicles, in ord c, as the planned <u>Justification</u> nstrates the tech iveness. Enabli	er to effectivel l efforts were r nologies to en ing technologie	y manage and not space unique able advanced es include ther	l provide oversig ue. d access-to-space mal protection,	the of the efforts e aerospace veh structures, vehi	icles that deli cle systems, c	enfigurations, a	efforts in Proje y capability, erodynamics, a	nd
(U) (U) (U) (U) (U) (U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop the airframe high altitude aerospace vehicles. In FY 2007: Continued developing the ai reusable access to space systems including system technologies that enable aerospace and cost-effectiveness. In FY 2008: Not Applicable. In FY 2009: Not Applicable. Total Cost	(\$ in Millions) and payload te rframe and payl g the thermal pr e vehicles to exh	chnologies req oad technolog otection, struct hibit revolution	uired to enable ies required to tural, configur ary capability	e horizontal laur enable next gen ation, and vehic , operability, res	nch of reusable leration le and payload ponsiveness,	E	<u>7 2007</u> 2.686 2.686	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
an a	C Other Breason Funding Summer (in Milliong)								
(U) 7 G	<i>EY</i> <i>EY</i> <i>C</i> his project has been oordinated through the Reliance process to harmonize fforts and eliminate duplication.	<u>2007 FY</u> <u>Actual Es</u>	<u>7 2008 F</u> stimate J	Y 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	<u>FY 2012</u> Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
(U) <u>I</u> N	D. Acquisition Strategy Not Applicable.									
Proje	ot 99SP			R-1 Line Ite Page-8	em No. 20 3 of 8 4				Exhibit R-2a (PE 0603211F)

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

	Exhit	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDGET 03 Adv	BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603216F Aerospace Propulsion and Power Technology									
	Cost (\$ in Millions)	FY 2007 Actual	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	150.123	142.543	170.856	189.246	174.017	135.561	129.752	Continuing	TBD
10SP	Space Rocket Prop Demo	26.778	34.079	23.532	32.443	38.523	35.265	35.417	0.000	0.000
2480	Aerospace Fuels	17.979	8.666	11.387	12.203	10.646	8.416	8.546	Continuing	TBD
3035	Aerospace Power Technology	13.800	14.379	8.864	9.545	9.623	9.719	9.561	Continuing	TBD
4921	Aircraft Propulsion Subsystems Int	27.413	24.696	42.383	39.537	53.046	21.284	20.137	Continuing	TBD
4922	Space & Missile Rocket Propulsion	4.652	4.703	5.082	2.094	2.847	5.465	4.122	Continuing	TBD
5098	Advanced Aerospace Propulsion	32.839	21.741	22.984	24.306	14.945	23.271	21.731	Continuing	TBD
681B	Advanced Turbine Engine Gas Generator	26.662	34.279	56.624	69.118	44.387	32.141	30.238	Continuing	TBD

Note: In FY 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. Aerospace Fuels and Atmospheric Propulsion develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems for high-speed/hypersonic flight. Aerospace Power Technologies develops and demonstrates power and thermal management systems for weapons and aircraft as part of Integrated Vehicle Energy Technology (INVENT). Advanced Turbine Engine Gas Generator (ATEGG) develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems. Aerospace Propulsion Subsystem Integration (APSI) integrates the engine cores demonstrated in ATEGG with low-pressure components into demonstrator engines. Turbine engine propulsion projects within this program are part of Versatile Affordable Advanced Turbine Engine (VAATE). 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. Advanced Aerospace Propulsion develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based). Space and Missile Rocket Technology develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. Space and Rocket Propulsion Demonstration 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 Integrated High Payoff Rocket Propulsion Technology (IHPRPT), which includes the area of Technology for the Sustainment of Strategic Systems. Note: In FY 2008, Congress added \$2.0 million for Bi-Polar Wafer-Cell Metal Hydride Batteries; \$1.0 million for Ceramic Matrix Composite (CMC) Airfoil Enhancements; \$6.4 million for a Family of Motors Capability Demonstration; \$1.0 million for FRESH Field Renewable Energy

Exhibit R-2 (PE 0603216F)

	Exhibit R-2, RDT&E B	udget Item Justification	DATE Februa	ry 2008
BUD 03	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and	Power Technology	
	System Hybirds; \$5.5 million for Silicon Carbide Power Electronic Studies; \$3.6 million for VAATE Small Turbofan engine technolog Activity 3, Advanced Technology Development, since it develops have military utility and address warfighter needs.	cs for More Electric Aircraft; \$1.2 million for the Texas Researce gy; and \$4.8 million for a VAATE High Speed Turbine Demon and demonstrates technologies for existing system upgrades and	ch Institute for Enviornmenta strator. This program is in Bu d/or new system developmen	l udget ts that
(U)	B. Program Change Summary (\$ in Millions)			
(U) (U) (U) (U)	Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Increases Reprogrammings SBIR/STTR Transfer <u>Significant Program Changes:</u> Not Applicable. C. Performance Metrics (U) Under Development.	<u>FY 2007</u> 145.891 150.123 4.232 7.634 -3.402	<u>FY 2008</u> 117.990 142.543 24.553 25.500	<u>FY 2009</u> 163.066 170.856
		R-1 Line Item No. 21 Page-2 of 27	Exhibit F	R-2 (PE 0603216F)
		326		

	Ex	hibit R-2a, I	RDT&E Pro	ject Justifi	ication			DAT	[⊤] ∈ February	2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)					E NUMBER AND 603216F Aer Power Techno	o TITLE ospace Prop blogy	ulsion and	PROJECT NU 10SP Spac	MBER AND TITLE e Rocket Prop	Demo
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
10SP	Space Rocket Prop Demo	26.778	34.079	23.532	32.443	38.523	35.265	35.41	7 0.000	0.000
	Quantity of RDT&E Articles	0	0	0	0	0	0		0	
order	to more effectively manage and provide of A Mission Description and Budget Iter	oversight of the e	fforts.	on and Power I	lechnology, Pro	oject 5055, Spa	ce Rocket Pro	puision Demo	onstration, to this	Project in
	Systems Phase 1. Characteristics such as costs are emphasized. Increased life and p technologies for station-keeping and on-or advanced propulsion technologies, higher high-energy propellants. Technological a percent, and reduce launch, operations, an reusable launch systems. Technology adv capability, a 25 percent reduction in orbit High Payoff Rocket Propulsion Technology rocket propulsion technology on national	environmental a performance of p rbit maneuvering efficiency energ dvances develop d support costs l vances could also transfer operation gy (IHPRPT), a space launch nee	cceptability, af propulsion syste g applications. y conversion s ed in this prog by approximate b lead to seven- nal costs, and a joint Departme eds.	fordability, reli ems are key goa Technology ar ystems (derived ram could impr ely 30 percent. year increase in a 15 percent inc nt of Defense, 1	ability, respons als. This project eas investigated d from an impro- rove the perform Responsivenes in satellite on-or crease in satellite National Aeron	siveness, reduc ct also develop d include grour oved understan nance of expen s and operabili bit time, a 50 p te payload. Th autics and Spa	ed weight, and s chemical, ele ad demonstrati ding of combu dable payload ty of propulsio percent increas e efforts in thi ce Administra	I reduced oper ectrical, and second of compa- ustion fundam capabilities b on systems wi se in satellite r s project cont tion, and indu	ration and launch olar rocket propu ct, lightweight, entals), and by approximately ll be enhanced for naneuvering ribute to Integrat stry effort to foct	lsion 20 or ed us
(U)	B. Accomplishments/Planned Program	n (\$ in Millions)					F	Y 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop liquid rock	et propulsion tec	hnology for cu	rrent and future	e space launch	vehicles. Note	: 2	20.351	22.177	17.884
	In FY 2009, a portion of the funding was	s moved to suppo	ort higher Air F	Force priorities.	1					
(U)	In FY 2007: Completed testing of advan	ced lightweight	thrust chamber	and nozzle tec	hnologies. Cor	nducted				
	scale-up of advanced cryogenic upper sta	age technologies	including high	er efficiency en	nergy conversion	on systems.				
	Completed hardware design for advanced	d cryogenic uppe	er stage technol	logies - turbopu	imps and thrust	chambers.				
	Began studies for advanced hydrocarbon	engine technolo	gies for future	reusable launcl	h vehicles.	1.1				
(U)	In FY 2008: Begin hardware fabrication	for advanced cr	yogenic upper	stage technolog	gies - turbopum	ps and thrust				
	Begin preparations for testing of these co	mpopents Star	t component ar	d engine desig	sis tools being (l hydrocarbon				
	engine technologies for future reusable l	aunch vehicles	Initiate an adv	anced manufact	uring technolog	av demo aimed	I			
	at materials and processes to support the	hydrocarbon en	vine technology	v development	effort Initiate	advanced	L.			
	hydrocarbon fuels scale-up effort to prov	ve out advanced	nydrocarbons a	s fuels or addit	ives to rocket e	ngine fuels and	1			
Proje	ect 10SP			R-1 Line Iten Page-3 c	n No. 21 of 27				Exhibit R-2a ((PE 0603216F)
				307	,					

	Exhibit R-2a, RDT&E Project	Justification	DA	February	/ 2008
BUDG 03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsic Power Technology	PROJECT N 10SP Spa	UMBER AND TITLE ce Rocket Prop	Demo
(U)	B. Accomplishments/Planned Program (\$ in Millions) for potential use in future reusable launch vehicles.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Complete advanced cryogenic upper stage hardware fabrication validate and verify modeling and simulation tools developed. Develop hydrod integration and demonstration in an advanced hydrocarbon engine concept for Continue material manufacturing scale-up effort to support hydrocarbon boost advanced hydrocarbon fuel/additive scale-up and proof efforts.	and begin testing components to carbon engine components for r future reusable launch vehicles. t demonstration program. Continue			
(U)					
(U)	MAJOR THRUST: Develop solar electric propulsion technologies for existin orbit transfer vehicles, and satellite formation flying, station keeping, and repo	ng and future satellites, upper stages,	5.088	4.435	3.765
(U) (U) (U)	In FY 2007: Developed electric propulsion systems for orbit-transfer by deve capable of Low Earth Orbit to Geosynchronous Orbit transfer. Began comport thruster demonstration. Completed test flight of the advanced small satellite p microsatellite demonstration. Supported test flight of propulsive attitude cont demonstration. Initiated hardware scale-up for an advanced multi-mode (high system for satellites. Developed satellite sensors to analyze satellite thruster i In FY 2008: Continue development of electric propulsion systems for orbit-tr thrusters capable of Low Earth Orbit to Geosynchronous Orbit transfer. Contt high-power Hall thruster demonstration. Continue hardware scale-up for an a high efficiency) propulsion system for satellites. Complete development of sa thruster interactions. In FY2009: Continue development of electric propulsion systems for orbit-tra thrusters capable of Low Earth Orbit to Geosynchronous Orbit transfer. Cond high-power Hall thruster demonstration. Continue hardware scale-up for an a high efficiency.	eloping high-power Hall thrusters ment integration for the high-power Hall propulsion demonstration unit for a rol system on microsatellite a thrust or high efficiency) propulsion nteractions. ransfer by developing high-power Hall inue component integration for the dvanced multi-mode (high thrust or atellite sensors to analyze satellite ansfer by developing high-power Hall luct and complete testing of the dvanced multi-mode (high thrust or			
	for satellites.	idvanced chemical propulsion system			
(U) (U)	MAJOR THRUST: Develop electric and advanced chemical based monoprop future satellite propulsion systems	pellant propulsion technologies for	1.339	1.109	1.883
(U)	In FY 2007: Began development of an advanced monopropellant thruster and monopropellant thruster technologies	l complete development of			
(U)	In FY 2008: Continue development of an advanced monopropellant thruster.				
Proj	ect 10SP	1 Line Item No. 21 Page-4 of 27		Exhibit R-2a	(PE 0603216F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUDG 03 A	GET ACTIVITY dvanced Technology Developi	ment (ATD)			PE NUMBER AND TITLE PROJECTION PROJECTI PROJECTICA PROJ				ECT NUMBER AND TITLE Space Rocket Prop Demo		
(U) (U)	B. Accomplishments/Planned Pr In FY 2009: Continue development	ogram (\$ in Mil nt of an advanced	<mark>lions)</mark> l monopropella	nt thruster techn	ologies.		F	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U)	CONGRESSIONAL ADD: Family In FY 2007: Not Applicable. In FY 2008: Scale-up and test of so of motors construct.	v of Motors Capa blid rocket motor	bility Demonstr	ration hnologies to pro	ovide data on via	bility of a family	7	0.000	6.358	0.000	
(U) (U)	In FY 2009: Not Applicable. Total Cost							26.778	34.079	23.532	
(U) (U) (U)	C. Other Program Funding Sumr Not Applicable. D. Acquisition Strategy Not Applicable.	nary (\$ in Millio <u>FY 2007</u> <u>Actual</u>	ns) <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>	<u>Total Cost</u>	
Proj	ect 10SP			R-1 Line Pag	e Item No. 21 e-5 of 27				Exhibit R-2a	(PE 0603216F)	

	Ex	hibit R-2a, F	RDT&E Pro	oject Justifi	ication				DATE	February	2008
BUDGI 03 Ac	ET ACTIVITY Ivanced Technology Development	(ATD)		P 0 P	E NUMBER AND 603216F Aero Power Techno	o TITLE ospace Prop blogy	ulsion and	PROJEC 2480 A	T NUMB erospa	BER AND TITLE	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2	013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	DATE February Propulsion and PROJECT NUMBER AND TITLE 2480 Aerospace Fuels 1 1 FY 2012 FY 2013 Cost to e Estimate Estimate Complete 646 8.416 8.546 Continuing 0 0 0 0 0 ve cycle technologies, alternative hydrocarbon jet echnologies, including technologies for flexibility, and performance while reducing weighthermally stable, high-heat sink, and controlled anced propulsion systems. The project also develot ture aerospace systems. The advanced propulse of into Versatile Affordable Advanced Turbine exit develops component technology for an adaptimission needs. <u>FY 2007</u> 3.929 <u>FY 2008</u> 3.929 3.960 w and				
2480	Aerospace Fuels	17.979	8.666	11.387	12.203	10.646	8.416		8.546	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0		
Note: impro	The funding in this project has been incr ved fuel efficiency.	eased due to emp	phasis on comp	ponent develop	ment in support	t of adaptive cy	cle technologi	es, altern	iative h	ydrocarbon jet	fuel, and
f c c e H c	This project develops and demonstrates in high-speed/hypersonic flight and technolo fuel consumption, and cost of ownership. chemically reacting fuels for a convention and demonstrates fuel system components emphasis is on demonstrating concepts fo Engine (VAATE). A portion of this proje cycle engine architecture that provides op	nproved hydroca ogy to increase tu The advanced f al turbine engine s that minimize c r combined cycle ect supports the d timized performa	rbon fuels and rbine engine o fuel emphasis i e, turbine-based ost, reduce ma e, ramjet, and s lemonstration c ance, fuel effic	advanced, nov perational relia s on developing d combined cyc intenance, and cramjet engine of adaptive cycl iency, and dura	el aerospace pro- bility, durability g and demonstra- cle engines, and improve perfor s. This project le technologies. ability for widel	y, mission technology, mission flex ating new therr other advance mance of futur is integrated in This project do y varying miss	ibility, and per nally stable, h d propulsion s e aerospace sy to Versatile A evelops compo- ion needs.	formance gh-heat stems. T ffordable onent tecl	e while sink, an The pro The advar Advar hnology	reducing weig ad controlled oject also devel anced propulsi- nced Turbine y for an adaptiv	ght, lops on ve
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Demonstrate therma capacity (performance), minimize fuel co demonstrate technologies that enable the cooling requirements and specifications is thermal management technologies, inclu- temperature/thermally efficient fuel pum out due to emphasis on component devel	n (\$ in Millions) ally stable fuels a oking, and reduce use of domestic for an adaptive c ding high heat si ps for mission ac opment in suppo	nd fuel system e fuel system n fuel sources fo ycle engine arc nk fuels, coole daptive engines ort of adaptive o	hardware conc naintenance. Ic or military energ chitecture. Des d cooling air sy s. Note: Decre cycle technolog	cepts to enhance dentify, develop gy needs. Dete ign, fabricate, a ystems, and higl eased funding in gies.	e cooling o, and rmine fuel and test key h n FY 2009 and	EY	<u>7 2007</u> 3.929		<u>FY 2008</u> 3.960	<u>FY 2009</u> 1.936
(U) (U)	In FY 2007: Studied, tested, and demons alternative energy resources and hardwar improve fuel system durability, and redu Initiated demonstrations of fuel performa In FY 2008: Continue demonstrations of regime, as might be encountered in an en- benefits from the use of alternative fuels, properties, including low temperature vis alternative fuels. Develop relationship b	strated advanced re concepts that c ce maintenance of ance at fuel temp f fuel combustion ngine employing . Develop relation scosity and therm etween fuel/mate	high heat sink can increase en due to fuel deg eratures in the n performance a cooled coolin onship between nal/storage stab erial interaction	fuels including gine performar radation in airc supercritical re at fuel tempera ng air system. alternate fuel bility. Improve ns and fuel (and	g those produce nee at high temp graft and engine ggime. tures in the sup Demonstrate en composition and physical prope I material) struc	d from peratures, hardware. ercritical gine durability d key rty models for cture.	,				
Proje	ct 2480			R-1 Line Iten Page-6 c	n No. 21 of 27					Exhibit R-2a (PE 0603216F)

	Exhibit R-2a, RDT&E Project Just	ification		DATE February 2008		
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJEC 2480 A	T NUMBER AND TITLE		
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Continue demonstration of engine and airframe durability and perform alternative fuels. Continue development of knowledge base needed for Air Force-w fuels, especially biofuels. Continue demonstration of cooled cooling air systems and management systems. Determine fuel structure changes required to increase specific elastomer swell agents capable of increasing swell to typical JP-8 levels. Begin deter requirements for biomass-derived alternative fuels. Develop key thermal management heat sink fuels, cooled cooling air systems, and high temperature/thermally efficient	ance benefits from the use of ide certification of alternative d other advanced aircraft thermal c gravity to 0.775. Determine ermination of new specification ent technologies, including high fuel pumps.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	MAJOR THRUST: Determine fuel cooling requirements and specifications for adva directed energy weapons that will meet the needs of evolving manned systems and u Note: In FY 2008 funding decreases due to higher Air Force priorities.	anced aircraft sensors and nmanned aerial vehicle (UAVs).	2.081	0.972	3.872	
(U)	In FY 2007: Demonstrated advanced low temperature and enhanced performance fu focusing on technologies that expand the flight envelope, range, or duration of UAV management concepts.	tels for UAV applications is to include advanced thermal				
(U)	In FY 2008: Continue to demonstrate advanced low temperature and enhanced performance applications and the Highly Efficient Embedded Turbine Engine (HEETE), focusing management technologies that expand the flight envelope, range, or duration of UA'	ormance fuels for UAV g on advanced thermal Vs.				
(U)	In FY 2009: Demonstrate an advanced UAV/HEETE thermal management system t system, as well as advanced approaches for ensuring fuel flow in wing tanks under h conditions.	hat includes a cooled cooling air high altitude, long endurance				
(U) (U)	MAJOR THRUST: Develop and demonstrate efficacy of low-cost, environmentally soot particulate emissions from gas turbine engines using advanced research combus Note: In FY 2007, funding from this Project was moved to support higher Air Force Advanced Aerospace Propulsion, in this PE. Funding shift caused delay in develop	r friendly fuel additives to reduce stors and small turbine engines. priorities in Project 5098, nent of this effort.	2.081	0.972	0.569	
(U)	In FY 2007: Demonstrated advanced additives to reduce soot and nitrogen oxides exconcepts including combined cycle engines.	missions in advanced propulsion				
(U)	In FY 2008: Demonstrate advanced particulate measurement diagnostics suitable fo Initiate demonstration of fuel/combustor concepts that reduce both soot and NOx.	r full-scale engine testing.				
(U)	In FY 2009: Continue to demonstrate advanced particulate measurement diagnostic testing. Continue demonstration of fuel/combustor concepts that reduce both soot ar	s suitable for full-scale engine nd NOx.				
Proj	ect 2480 R-1 Line I Page- 3	tem No. 21 7 of 27 31		Exhibit R-2a (I	PE 0603216F)	

	Exhibit R-2a, RDT&E Project Justi	Exhibit R-2a, RDT&E Project Justification						
BUD(03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJEC 2480 A	T NUMBER AND TITLE erospace Fuels				
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions)	E	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U)	MAJOR THRUST: Develop and demonstrate enhancements to fuel system technolog from this Project was moved to support higher Air Force priorities in Project 5098, A in this PE. Funding shift caused delay in development of this effort.	gy. Note: In FY 2007, funding dvanced Aerospace Propulsion,	1.387	0.972	1.025			
(U)	In FY 2007: Designed, developed, and demonstrated hardware and fuel system simult temperature fuel system components of reusable aerospace vehicles focusing on aeros and combined cycle engines that require high levels of cooling.	lators to evaluate key high space vehicles with advanced						
(U)	In FY 2008: Develop combined cycle engine cooling systems, utilizing 2nd-generation advanced fuels.	on endothermic fuels and other						
(U)	In FY 2009: Continue development and demonstration of combined cycle engine cocutilizing 2nd-generation endothermic fuels and other advanced fuels.	oling systems and technologies						
(U)								
(U)	MAJOR THRUST: Identify, develop, and demonstrate low-cost approaches to reduc for the Expeditionary Air Force. Note: In FY 2008, funding from this Project was m Force priorities in Project 5098, Advanced Aerospace Propulsion, in this PE. Fundin development of this effort.	ing the fuel logistics footprint loved to support higher Air g shift caused delay in	2.080	0.598	1.025			
(U)	In FY 2007: Demonstrated advanced nano-technology fuel additives, nano-technolog detection and mitigation technologies for biological growth.	gy fuel sensors, and novel						
(U)	In FY 2008: Develop model for growth and spread of biological materials through fu to demonstrate advanced nano-technology fuel additives, nano-technology fuel senso mitigation technologies for biological growth.	el handling systems. Continue rs, and novel detection and						
(U)	In FY 2009: Develop ability to model spread of biological materials through fuel har demonstration of advanced additives to mitigate biological growth in conventional ar	ndling systems. Initiate ad alternative aerospace fuels.						
(U)		L						
(U)	MAJOR THRUST: Assured Fuels Initiative: Characterize and demonstrate the use of fuel to comply with Air Force certifications and standards for jet fuels. Note: Fundir FY 2009 due to increased emphasis on development of alternative hydrocarbon jet fu	of alternative hydrocarbon jet ng re-directed within BPAC in el.	0.000	0.000	2.960			
(U)	In FY 2007: Not Applicable.							
(U)	In FY 2008: Not Applicable.							
(U)	In FY 2009: Determine fuel structure changes required to increase specific gravity to swell agents capable of increasing swell to typical JP-8 levels. Begin determination of	0.775. Determine elastomer of new specification						
Proj	ect 2480 R-1 Line Ite Page-&	em No. 21 3 of 27		Exhibit <u>R-2a (</u> F	PE 0603216F)			
	33	32						

Exhibit R-2a, RDT&E Proje	Exhibit R-2a, RDT&E Project Justification							
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NU 2480 Aero:	OJECT NUMBER AND TITLE 80 Aerospace Fuels					
(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> requirements for biomass-derived alternative fuels.	<u>F</u> Y	<u> </u>	<u>FY 2008</u>	<u>FY 2009</u>				
 (U) (U) CONGRESSIONAL ADD: Assured Fuels Process Demonstration Unit. (U) In FY 2007: Developed capability to investigate relationship between alter resulting fuel properties. Researched effects of feedstock (coal, biomass, e 	tive jet fuel production processes and) on resulting jet fuel properties.	4.476	0.000	0.000				
 (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. (U) (U) CONGRESSIONAL ADD: Flexible JP-8 Military Fuel Certification. (U) In FY 2007: Supported development of lean process for certifying non-pet 	eum-derived jet fuels for Air Force	1.945	0.000	0.000				
 systems. Procured and tested non-petroleum fuels as required for certificat (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. (U) (U) CONGRESSIONAL ADD: Texas Research Institute for Environmental Str (U) In FY 2007: Not Applicable. (U) In FY 2008: Continue with the development of a small (air-portable) municipality 	0.000	1.192	0.000					
 (U) In FY 2009: Not Applicable. (U) (U) Total Cost 		17.979	8.666	11.387				
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2008</u> <u>Actual Estimate Esti</u>	09 <u>FY 2010 FY 2011 FY 2012</u> ate <u>Estimate Estimate</u> Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> ,	<u>Total Cost</u>				
 (U) Related Activities: (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602102F, Materials. (U) PE 0602204F, Aerospace Sensors. (U) PE 0603112F, Advanced Materials for Weapons Systems. 								
Project 2480	1 Line Item No. 21 Page-9 of 27		Exhibit R-2a (Pl	E 0603216F)				

	Exhibit R-2a, RDT&	Exhibit R-2a, RDT&E Project Justification					
BUDGET 03 Adv	T ACTIVITY vanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion ar Power Technology	PROJE 2480	CT NUMBER AND TITLE Aerospace Fuels			
(U) <u>C</u> (U) Th co Ra ha du	. Other Program Funding Summary (\$ in Millions) his project has been bordinated through the eliance 21 process to armonize efforts and eliminate uplication.						
No No	ot Applicable.						
Project	t 2480	R-1 Line Item No. 21 Page-10 of 27		Exhibit R-2a (PE 0603216F)			

Exhibit R-2a, RDT&E Project Justification									February	2008
BUDG 03 A (ET ACTIVITY dvanced Technology Development (ATD)			PE NUMBER AND 0603216F Aero Power Techno	TITLE DSpace Prope Plogy	ulsion and	PROJECT NUME	NUMBER AND TITLE Prospace Power Technology	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
2025	Aarospace Dower Technology	Actual	Estimate 14 270	Estimate	Estimate	Estimate	Estimate 0.710	Estimate	Complete	трр
3035	Quantity of RDT&F Articles	13.800	14.379	0.004	9.545	9.023	9.719	9.301	Continuing	
	Mission Description and Budget Ham	Jugtifi agtion	0	0	0	0	0	0		
	This project develops and demonstrates ele survivability, and reduces vulnerability, we are projected to provide a two- to five-fold also develops and demonstrates electrical p B. Accomplishments/Planned Program MAJOR THRUST: Develop electrical pc integration with directed energy weapons operation of DEW. Note: In FY 2008 an priorities. In FY 2007: Completed design and perfo duty cycle generator system tailored to dir In FY 2008: Perform test of high power r In FY 2009: Not Applicable. MAJOR THRUST: Develop power gener	ectrical power, the eight, and life cy improvement in power and therm (§ in Millions) ower and therma (DEW). These d FY 2009, the rmed modeling rected energy w negawatt class l ration/condition	hermal manage rele costs for m h aircraft reliab hal management l management technologies w efforts in this t and simulation eapons. ow duty cycle	ement, and dis nanned and un pility and main at technologies component su vill enable the hrust are redu- n of a megawa power genera n component.	tribution for aero manned aerospan ntainability, and a s to enable solid absystem technol delivery of high ced due to highe tt non-supercond tion technology.	ospace applicat ce vehicles. Th a 20 percent rea state high power logies for power for r Air Force lucting low	ions. This tec ne electrical p duction in pow er density sou <u>F</u>	chnology enhanc ower system cor ver system weig rces. <u>Y 2007</u> 0.869 0.869	es reliability ar nponents devel ht. This projec <u>FY 2008</u> 0.237 0.000	nd oped t <u>FY 2009</u> 0.000 3.900
(U) (U) (U) (U) (U) (U) (U)	management components and subsystem i These technologies will improve aircraft s weight/volume ratios, while reducing life within this thrust were transferred from of FY 2009. In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Begin design of high temper MAJOR THRUST: Develop electrical po special purpose applications. Note: In FY In FY 2007: Investigated alternative energy	technologies for self-sufficiency, cycle costs and ther efforts with rature demonstra ower and therma Y 2008, this acti gy storage/gene	integration int reliability, ma enabling new in this project ator and fabrica l management vity will be co ration systems	ation of key co components a mpleted. for low powe	future high powersupportability, ar supportability, ar Note: In FY 20 orities. Efforts w components. and subsystem te er applications.	er aircraft. nd system 06 the efforts vill resume in chnologies for		1.413	2.255	0.000
				R-1 Line Ite	em No. 21					
Proje	ect 3035			Page-11	l of 27				Exhibit R-2a (F	PE 0603216F)

	Exhibit R-2a, RDT&E Project Just	ification	I	DATE February	2008
BUDC 03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT 3035 Ae	NUMBER AND TITLE rospace Power T	echnology
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Develop and fabricate high power density and high energy density fuel and power and thermal management/distribution components and subsystems. Delive a 50% weight reduction.	cell and battery energy storage er for field tests to demonstrate	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	In FY 2009: Not Applicable.				
(U)	MAJOR THRUST: Develop analytical tools and subsystems for multi-megawatt sup systems including power generation, conditioning, thermal management, and dynami 2009, efforts in this thrust closed out due to higher Air Force priorities.	3.151	3.443	0.000	
(U) (U) (U) (U)	In FY 2007: Began detailed design of megawatt class power demonstrator and began In FY 2008: Design and fabricate multi-megawatt superconducting power and therm In FY 2009: Not applicable.	n fabrication of key components. nal management components.			
(U)	MAJOR THRUST: Develop power and thermal management components and subsy and future high power aircraft systems applications. These technologies will enable of management acquisition, storage, and transport for power on demand with increased affordability. Note: In FY 2009, the efforts within this thrust were transferred from due to increased emphasis on component and subsystem development in support of h	vstems technologies for fielded efficient power and thermal system reliability and other efforts within this Project high power aircraft systems.	0.000	0.000	4.964
(U) (U) (U)	In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Investigate, design, and develop efficient, lightweight, wide temperatur electronics, motor controls, actuators, heat exchangers, and thermal management con	e range, rugged/robust power nponents and subsystems.			
(U) (U) (U) (U)	CONGRESSIONAL ADD: Field Renewable Energy System Hybrids (FRESH) Li Io In FY 2007: Developed Li-Ion battery powered field renewable energy systems. In FY 2008: Investigate, design, and develop lightweight rechargeable batteries for a applications enabling carry of lightweight energy systems in the field for sustained or renewable/portable energy sources. Focus is on decreasing size/weight of batteries; i extreme environmental functionality, and implementing state-of-charge communicat	on Battery Program. airman portable power perations using increasing energy density, and ion.	0.973	0.993	0.000
(U) (U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Development of Bi-Polar Wafer-cell NI-MH Battery.		0.973	1.987	0.000
Proj	ect 3035 R-1 Line It Page-1	em No. 21 2 of 27		Exhibit R-2a	(PE 0603216F)

		Exhibit R-2a, RDT&E Project Justification								
BUD(03 A	GET ACTIVITY Advanced Technology Develop	ment (ATD)			PE NUMBER A 0603216F A Power Tech	ND TITLE erospace Pro inology	PROJECT NUMBER AND TITLE 3035 Aerospace Power Technol			
(U) (U) (U)	B. Accomplishments/Planned Pr In FY 2007: Evaluated the viabilitienvironmental minimum/no maint lead-acid batteries for military airco In FY 2008: Modify the existing In technology for potential application deliver a prototype 28 V Li-ion ce	ogram (\$ in Mil ty of advanced ni enance replacem graft applications Ni-MH battery bi n in the F-35 aird ll pack	lions) ickel-metal hydr ent for existing polar wafer cell craft in both the	ride battery techn vented nickel-ca design and cher 28 V and the 27	nology to provid dmium and valv nistry for use wi 0 V batteries. D	e an re regulated ith Li-ion emonstrate and	F	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	In FY 2009: Not Applicable.									
(U) (U) (U)	CONGRESSIONAL ADD: Silico In FY 2007: Extended the present (JFET) technologies. Evaluated ne the development of low specific on In FY 2008: Extend development	6.421	5.464	0.000						
(0)	at 800 and 1200V for enhancemen	t mode VJFETs	with low specifi	c on-resistance.	sinnents to large		cu			
(U) (U)	In FY 2009: Not Applicable. Total Cost							13.800	14.379	8.864
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	ons)							
		FY 2007 Actual	<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) (U)	Related Activities: PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace									
(U)	Propulsion. PE 0602605F, Directed Energy									
(U)	PE 0603605F, Advanced Weapons Technology.									
(U)	This project has been coordinated through the Reliance 21 process to									
Pro	ject 3035			R-1 Line Page	Item No. 21 -13 of 27				Exhibit R-2a	(PE 0603216F)
				:	337					

Exhibit R-2a, RDT&E I	Project Justification	DATE February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion an Power Technology	PROJECT NUMBER AND TITLE 3035 Aerospace Power Technology
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> harmonize efforts and eliminate duplication.		
(U) D. Acquisition Strategy Not Applicable.		
Project 3035	R-1 Line Item No. 21 Page-14 of 27 338	Exhibit R-2a (PE 0603216F)

	ExI	hibit R-2a, I	RDT&E Pro	ject Justif	ication			DA	TE February	2008
BUDGI 03 Ac	ET ACTIVITY Ivanced Technology Development (ATD)		F Q F	PE NUMBER AND 0603216F Aer Power Techno	o TITLE ospace Prop plogy	ulsion and	PROJECT NU 4921 Aircr Int	JMBER AND TITLE	Subsystems
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2010 FY 2011 FY 201		FY 2013	Cost to	Total
	Cost (\$ III MIIIIOIIS)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4921	Aircraft Propulsion Subsystems Int	27.413	24.696	42.383	39.537	53.046	21.284	20.1	37 Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0	
vv s a ((a a F f c c i i v V f t t t t t	This project develops and demonstrates tec weight, fuel consumption, and cost of own such as Joint Technology Demonstrator Er applications. Demonstrator engines integr low-pressure spool) technology such as fa activities under national Propulsion Safety power and thermal management subsystem consumption, surge power for successful encreased mission effectiveness. Technology Versatile Affordable Advanced Turbine Er Anticipated technology advances include t ime on station with 10 times power output VAATE provides continuous technology to urbine engine industry's international com echnology for an adaptive cycle engine ar	chnology to incr ership. This pro- agine for manne ate core (high-p ns, turbines, en And Readiness ns technologies. ngagements, hig ogies developed ngine (VAATE) urbine engine in t for surveillanc ransition for mi petitiveness. A chitecture that p	rease turbine er oject includes A d systems and ressure spool) gine controls, r (PSAR). This APSI provide gh sortie rates are applicable b, which is focu nprovements p e aircraft, and p litary turbine er portion of this provides optimi	agine operation Aerospace Prop Joint Expendal technology dev nechanical syst project also for s aircraft with with reduced m to sustained hi used on improver roviding approp propulsion for angine upgrades project support ized performan	al reliability, du bulsion Subsyste ble Turbine Eng veloped under A tems, exhaust n bouses on integr potential for lor naintenance, red gh-speed vehicl ing propulsion of ing hyped sub- stantely twice a high speed sup and derivatives rts demonstration ce, fuel efficien	urability, missi- ems Integration gine Concept for Advanced Turb- ozzles, and aug- ration of inlets, nger range and luced life cycle les and respons capabilities wh the range for a personic missil s, and has adde on of adaptive of acy, and durabi	on flexibility, a n (APSI), which or unmanned ai ine Engine Gas gmentors. Add nozzles, engin higher cruise s cost, and impri- tive space laund ile at the same sustained supple with double ed dual-use ben cycle technolog lity for widely	and performa h includes de ir vehicle and s Generator p litionally, the e/airframe co speeds with la roved surviva ch. APSI sup time reducir ersonic comb the range for hefit of enhan gies, which d varying miss	ance, while reducing emonstrator engine d cruise missile project with engine ese efforts include compatibility, and ower specific fuel ability, resulting in pports goals of ing cost of ownersh boat aircraft, doubling time sensitive tar ancing United State levelop component sion needs.	ng es e n nip. ng gets. s t
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Design, fabricate, an engines. These technologies will improve	(\$ in Millions) d demonstrate c e durability, sup	lurability and in portability, and	ntegration tech d affordability	nologies for tur of current and f	bofan/turbojet uture Air Force	<u>FY</u>	<u>7 2007</u> 1.285	<u>FY 2008</u> 0.817	<u>FY 2009</u> 1.696
(U)	 J) In FY 2007: Fabricated agile combat support engine technologies to increase durability of components to include advanced aerodynamics for fans, turbines, mechanical systems, interactions between the inlet and fan, and controls/accessories. 									
(U)	In FY 2008: Begin testing agile combat s advanced aerodynamics for fans, turbines controls/accessories.	support engine t , mechanical sy	echnologies to stems, interact	increase durab ions between th	ility of compon ne inlet and fan,	ents to include , and				
(U)	In FY 2009: Complete testing and begin	validation of en	gine life mode	ls for engine co	omponents for a	agile combat				
Proje	ct 4921			R-1 Line Iter Page-15	n No. 21 of 27				Exhibit R-2a (PE 0603216F)

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	Exhibit R-2a, RDT&E Project Just	Exhibit R-2a, RDT&E Project Justification						
BUI 03	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJEC 4921 A Int	T NUMBER AND TITLE	Subsystems			
(U)	B. Accomplishments/Planned Program (\$ in Millions) support technologies. Initiate design of advanced features for durable fans, turbines interactions between the inlet and fan, and controls/accessories.	, mechanical systems,	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U) (U)	MAJOR THRUST: Design, fabricate, and test advanced component technologies for consumption of turbofan/turbojet engines for fighters, bombers, sustained supersoni surveillance aircraft and transports. Each of these component technology innovation part of the Air Force's engine inventory and offer potentially significant performanc engines enabling faster, more responsive systems with longer range and greater pay	or improved performance and fuel c and hypersonic cruise vehicles, ns can be applied to a significant e enhancements to future aircraft load. Design, fabricate, and test	9.138	8.830	33.906			
	advanced component technologies for improved performance, fuel consumption, du adaptive engines in full-engine environments. Note: In FY 2009, increased funding substantial testing that will begin on large demonstrator engines.	rability, and cost for mission g is for final assembly and						
(U)	(utilizes a hollow fan and radial compressor) capable of operating as primary propul advanced engine designs for a sustained supersonic engine using variable cycle feat turbine using cooled metal and cooled ceramic matrix composites (CMCs), and ligh	sion or in a lift mode. Enhanced ures, an advanced fan, improved tweight CMC cases and ducts.						
(U)	In FY 2008: Finish testing of lightweight high bypass engine components (utilizes a compressor) capable of operating as primary propulsion or in a lift mode. Begin fab advanced engine designs for a supersonic engine using variable cycle features, adva cooled metal and cooled CMCs, advanced augmentor, and lightweight CMC cases a preliminary design of advanced adaptive cycle (third air stream) engine technologie high work variable low turbine for long dwell time, controls, inlet integration, and a subsonic to sustained supersonic flight. Begin detailed design and procurement of advanced adaptive cycle (third air stream) engine technologies, including an advance turbine for long dwell time, controls, and advanced exhaust nozzle supersonic flight.	a hollow fan and radial prication and assembly of nced fan, improved turbine using and ducts. Begin and finish s, including an advanced fan, dvanced exhaust nozzle for long lead hardware for an ed fan, high work variable low for subsonic to sustained						
(U)	In FY 2009: Finish assembly and begin testing of engine designs for a supersonic a variable cycle features, an advanced fan, improved turbine using cooled metal and c augmentor, and lightweight CMC cases and ducts. Initiate design of high bypass up detailed design of advanced adaptive cycle (third air stream) engine technologies, in work variable low turbine for long dwell time, controls, inlet integration, and advanto sustained supersonic flight. Finish detailed design and initiate fabrication of advanced adaptive cycle (third air stream) engine technologies.	nd subsonic engine using ooled CMCs, advanced tra fuel efficient engine. Finish cluding an advanced fan, high ced exhaust nozzle for subsonic unced fan, high work variable low						
Ρı	oject 4921 R-1 Line Page-	16 of 27		Exhibit R-2a	(PE 0603216F)			

	Exhibit R-2a, RDT&E Project Justi		DATE February	uary 2008	
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJEC 4921 A Int	T NUMBER AND TITLE	Subsystems
(U)	B. Accomplishments/Planned Program (\$ in Millions) turbine for long dwell time, controls, inlet integration, and advanced exhaust nozzle for supersonic flight. Initiate preliminary design for a high bypass/high overall pressure a consumption.	E E E E E E E E E E E E E E E E E E E	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Design, fabricate, and test advanced component technologies for technologies improve performance, durability, and affordability of engines for missile (UAVs), and subsonic to hypersonic weapon applications. Note: In FY 2008 and out, component hardware fabrication and engine testing.	limited life engines. These e and unmanned air vehicles increased funding is to conduct	3.855	6.704	6.781
(U)	In FY 2007: Fabricated advanced high temperature cooled turbine blade and combust Began fabrication of advanced components for technologies for intelligent and durabi advanced fan/compressor, a ceramic turbine, turbine with new advanced cooling appr missile applications.	tor for UAV applications. lity engine testing to include an oach, and oil-less bearings for			
(U)	In FY 2008: Finish fabrication of engine components of advanced high temperature of combustor for UAV applications. Finish fabrication and begin assembly of advanced for engine testing to include an advanced lightweight fan/compressor, turbines with ne approaches, oil-less bearings and high through flow combustors for missile application components for technologies for engine testing to include an advanced light weight fanew advanced cooling approaches, oil-less bearings and high through thru flow combustors for missile application components for technologies for engine testing to include an advanced light weight fanew advanced cooling approaches, oil-less bearings and high thru flow combustors for the formation of the set of t	cooled turbine blade and components for technologies ew advanced cooling ns. Begin testing of advanced un/compressor, turbines with or missile applications.			
(U)	In FY 2009: Finish testing of advanced components for technologies for engine testin weight fan/compressor, turbines with new advanced cooling approaches, oil-less bear combustors for missile applications. Initiate design of a higher specific thrust low co turbine engine for improved fuel efficiency improving range. Initiate low spool comp subsonic unmanned turbofan engines.	ng to include an advanced light ings and high thru flow ost high mach expendable ponents for fuel efficient			
(U) (U)	CONGRESSIONAL ADD: Versatile Affordable Advance Turbine Engine (VAATE) add in FY 2007 was previously titled XTC58F Technology Versatile Affordable Adv. (Note: Only for the XTC 58F/1 demonstrator program).)-Small Turbofan (STF). This anced Turbine Engine Program	7.784	3.576	0.000
(U)	In FY 2007: Established conceptual design of highly efficient embedded turbine engi- core. Designed and evaluated high pressure compressor rig; improved bearings, impr- coating for the high pressure turbine. Assessed integration issues such as incorporation in EX 2008: This effort will add additional high pressure turbine component test time.	ine based around small turbofan roved seals, and thermal barrier on of variable exhaust nozzle.			
Proj	R-1 Line Ite act 4921 Page-1	em No. 21 7 of 27		Exhibit R-2a	(PE 0603216F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DA	February	2008
BUD 03 /	GET ACTIVITY Advanced Technology Developn	nent (ATD)			PE NUMBER A 0603216F A Power Tecl	ND TITLE Aerospace Pro Mology	pulsion and	PROJECT N 4921 Airc Int	UMBER AND TITLE raft Propulsion	Subsystems
(U)	B. Accomplishments/Planned Pro time, conceptual studies for Revolu costs.	ogram (\$ in Mil tionary Hunter-	<mark>lions)</mark> Killer core appli	ications with air	framers, and co	ver hardware	<u>F</u>	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	In FY 2009: Not Applicable.									
(U) (U) (U) (U)	CONGRESSIONAL ADD: Versat Demonstrator. This add in FY 2007 Missile Engine (formerly VAATE A In FY 2007: Defined and develope In FY 2008: Develop an advanced risk reduction efforts for the high sp In FY 2009: Not Applicable	ile Affordable A 7 was previously Advanced Super d Long Range S variable nozzle, peed engine den	Advance Turbine y titled Accelera rsonic Cruise M trike Mach 4+ e continue hardw honstrator.	e Engine (VAAT ation VAATE A issile Engine). expendable turbi vare materials pr	TE), High Speed dvanced Supers ne engine techn ocess developm	Turbine conic Cruise ologies. ent, and continu	e	5.351	4.769	0.000
(U)	Total Cost							27.413	24.696	42.383
(U)	C. Other Program Funding Summ	nary (\$ in Millio	ons)							
(U) (U) (U) (U)	Related Activities PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0603003A, Aviation Advanced Technology.	<u>FY 2007</u> <u>Actual</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 201</u> <u>Estima</u>	<u>3 Cost to</u> te <u>Complete</u>	<u>Total Cost</u>
(U) (U)	This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.									
Pro	oject 4921			R-1 Line Page	e Item No. 21 ⊶18 of 27 342				Exhibit R-2a (PE 0603216F)

	Exi	hibit R-2a, I	RDT&E Pro	ject Justifi	ication			DAT	E February	2008
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)		P 0 P	PE NUMBER AND 1603216F Aer Power Techno	o TITLE ospace Prop plogy	ulsion and	PROJECT NUI 4922 Space Propulsion	MBER AND TITLE & Missile Roc	:ket
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4922	Space & Missile Rocket Propulsion	4.652	4.703	5.082	2.094	2.847	5.465	4.12	2 Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0)	
	This project develops and demonstrates technologies for sustainment of strategic systems (including solid boost/missile propulsion, Post Boost Control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion systems, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances developed in this program are being accomplished in two phases to improve the performance of expendable systems' payload capabilities by approximately 25 percent (Phase I)/35 percent (Phase I)/35 percent (Phase II). Aging and Surveillance efforts could reduce lifetime prediction uncertainties for individual motors by 50 percent, enabling motor replacement for cause. This program is part of the Technologies for the Sustainment of Strategic Systems program and supports Integrated High Payoff Rocket Propulsion Technology (IHPRPT).									
(U)	B. Accomplishments/Planned Program	(\$ in Millions)					F	Y 2007	FY 2008	FY 2009
(U) (U) (U) (U) (U)	MAJOR THRUST: Develop and demonst technologies for ballistic missiles. Note: In FY 2007: Completed testing the first of In FY 2008: Complete testing of the second In FY 2009: Not Applicable.	strate missile pro- In FY 2008, th of two motors fo ond of two moto	opulsion and Po is effort will be or the Missile P rs for the Miss	ost Boost Contr completed. ropulsion Dem ile Propulsion I	rol Systems (PH constration. Demonstration.	3CS)		3.629	0.658	0.000
(U) (U)	MAJOR THRUST: Develop and demonstrategic systems. Efforts support Techno out, funding increase supports build up an In FY 2007: Completed modeling and sin components. Began development of subc simulation tools and updated the models of demonstration.	strate missile pro- plogy for Sustain ad testing in a fu- mulation tools d components to to with the resultin	opulsion, PBCS nment of Strate ill-scale missile evelopment for est the accuracy g data for use i	S, aging, and sugic Systems (T e propulsion de r analyzing and y of the previou in an upcoming	urveillance tech (SSS). Note: I emonstration. I developing mi usly developed g missile propul	nologies for n FY 2008 and issile modeling and sion		0.558	2.352	3.354
(U)	In FY 2008: Continue development of su and simulation tools and update the mode demonstration.	bcomponents to ls with the resu	test the accuration test the accuration test the accuration test the accuration test test test test test test test tes	acy of the previ se in an upcom	iously develope ing missile pro	ed modeling pulsion				
(\mathbf{U})	In F 1 2009: Complete sub-scale compon	ient developmei	us providing su	ud-scale validat	uon of modelin	g and				
Proj	act 4922			R-1 Line Iten	n No. 21 of 27				Exhibit R-20 (PE (1603216E)
110]0				34.3	}					

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008		
BUD(03 A	GET ACTIVITY dvanced Technology Develop	ment (ATD)			PE NUMBER A 0603216F A Power Tech	ND TITLE erospace Pro nology	PROJECT NUM 4922 Space Propulsion	ROJECT NUMBER AND TITLE 922 Space & Missile Rocket ropulsion				
(U)	B. Accomplishments/Planned Pr simulation tools. Initiate full-scale propellants, and advanced modelir	ogram (\$ in Mil e demonstration c ag and simulation	lions) of advanced mis tools.	sile propulsion c	components, adv	anced solid	F	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	MAJOR THRUST: Develop and a lifetime prediction uncertainties fo support Technology for Sustainme conduct demonstrations of aging a	demonstrate agin or individual moto ont of Strategic Sy nd surveillance to	g and surveillan ors by 50 percen ystems (TSSS). echnologies.	tce technologies at, enabling moto Note: FY 2008	for strategic sys or replacement for and out, funding	tems to reduce or cause. Efforts g increased to	S	0.465	1.693	1.728		
(U) (U)	In FY 2007: Initiated scale-up activities for an advanced service life prediction program integrating existing and advanced sensors, models, and tools to predict service life of a solid rocket motor on a motor-by-motor basis. In FY 2008: Continue scale-up activities for an advanced service life prediction program integrating existing and advanced sensors, models, and tools to be able to predict the service life of a solid rocket motor on a motor-by-motor basis.											
(U)	In FY 2009: Begin full-scale dem- validate and verify modeling and s	onstration of adv simulation tools a	anced aging and nd component t	l surveillance to echnologies.	ols for solid rock	ket motors to						
(U) (U)	Total Cost							4.652	4.703	5.082		
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u>	ons)									
		<u>FY 2007</u> <u>Actual</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	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>		
(U) (U) (U)	Related Activities: PE 0602102F, Materials. PE 0602203F, Aerospace Propulsion											
(U)	PE 0602601F, Spacecraft Technology.											
(U) (U)	PE 0603401F, Advanced Spacecraft Technology. PE 0603500F, Multi-Disciplinary Advanced											
(U)	Development Space Technology. PE 0603853F, Evolved			D 1 Line	Itom No. 21							
Proj	ect 4922			R-1 Line Page	-20 of 27		1		Exhibit R-2a ((PE 0603216F)		

Exhibit R-2a, RDT&E Project Just		DATE February 2008	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJEC 4922 S Propuls	T NUMBER AND TITLE pace & Missile Rocket sion
 (U) C. Other Program Funding Summary (\$ in Millions) Expendable Launch Vehicle Program. (U) PE 0603114N, Power Projection Advanced 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 4922 Page-2	21 of 27		Exhibit R-2a (PE 0603216F)

	E	xhibit R-2a, I	RDT&E Pro	ject Justi	fication			DATE	February	2008	
BUDGI 03 Ac	ET ACTIVITY Ivanced Technology Developmen	t (ATD)			PE NUMBER AND 0603216F Aer Power Techno	o TITLE ospace Prop blogy	ulsion and	PROJECT NUMBER AND TITLE 5098 Advanced Aerospace Propulsion			
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
5098	Advanced Aerospace Propulsion	32.839	21.741	22.984	4 24.306	14.945	23.271	21.731	Continuing	TBD	
Note	Quantity of RD1&E Articles	000 to support arc	U U	U utions and fab	D U	U objeles for fligt	U nt domonstrati	0			
(U) <u>4</u> e s (C) c r f (U) (U) (U) (U) (U)	A. Mission Description and Budget Ite This project develops and demonstrates, angine cycles (including turbine and roc cramjet engine. Multi-cycle engines with to 8+. Efforts include scramjet flow-p continuous positive thrust (even during re- ninimize thermal load imposed by the head or protecting low speed propulsion syste B. Accomplishments/Planned Progra MAJOR THRUST: Develop and demons- over a range of Mach 4 to 8. In FY 2007: Completed engine and vel- tested flight clearance engine and initia Initiated fabrication of air vehicle flight In FY 2008: Complete fabrication of a test centers (Air Force Flight Test Cent In FY 2009: Conduct integrated air vel-	em Justification via ground and fl ket-based) to provide provide propuls ath optimization to mode transition), re- igh-speed engine. ems (e.g., turbine (s.g., turbine) (s.g.,	ight tests, scrar ride the Air For sion systems fo o enable operat robust flame-ho Thermal man engines) during ies for a hydroo conducted vehi flight engines. gan flight test p ardware and fin a Test Center).	njet propulsio ce with transf r possible app ion over the v olding to main agement plays g hypersonic f carbon-fueled cle critical de Established f preparations at alize flight tes	on cycle to a tech formational milit plication to suppo- widest possible ra- atain stability thro s a vital role in so flight. scramjet with ro esign review. Fal flight test profiles t supporting test st preparations ar-	nology readine ary capabilities ort aircraft and ange of Mach n ough flow disto cramjet and con obust operation bricated and s and margins. centers. t supporting n and	ss level appro The primary weapon platfor numbers, active ortions, and man nbined cycle of <u>F</u>	priate for full in y focus is on hy rms operating of e combustion of aximized volum engines, includi <u>Y 2007</u> 32.839	ttegration with of drocarbon-fuele over a range of 1 ontrol to assure ne-to-surface are ng consideratio <u>FY 2008</u> 21.741	other ed, Mach ea to ns <u>FY 2009</u> 22.984	
(U)	reporting. Total Cost						:	32.839	21.741	22.984	
(U) (C. Other Program Funding Summary	y (\$ in Millions)									
(U) I (U) I (U) I	I Related Activities: PE 0602102F, Materials. PE060203F, Aerospace Propulsion.	FY 2007 FY Actual E	<u>7 2008 F</u> stimate 1	Y 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u> Complete	<u>Total Cost</u>	
Proje	ct 5098			R-1 Line Ite Page-22 34	em No. 21 2 of 27 •6				Exhibit R-2a (PE 0603216F)	

Exhibit R-2a, F	DATE February 2008	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUMBER AND TITLE 5098 Advanced Aerospace Propulsion
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> (U) This project will be 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. 21	

	Ex	hibit R-2a, I	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDGE 03 Ad	Exhibit R-2a, RDT&E Project ET ACTIVITY dvanced Technology Development (ATD) Cost (\$ in Millions) FY 2007 FY 2008 FY Actual Estimate Es Advanced Turbine Engine Gas Generator Quantity of RDT&E Articles 0 0 In FY 2008 and out, funding has been increased in FY 2008 and out due to erent embedded turbine engines, and small heavy fueled engines. A.Mission Description and Budget Item Justification This project develops and demonstrates technology to increase turbine engine weight, fuel consumption, and cost of ownership. The objective is to provide operformance, cost, durability, reparability, and maintainability can be assessed of the engine and nominally consists of a compressor, a combustor, a high-pred demonstration validates engineering design tools and enhances rapid, low-risk applied to derivative and/or new systems. These technologies are applicable to combat vehicles, ships, and responsive space launch. Component technologies components (such as inlet systems, fans, low pressure turbines, and exhaust sy management systems) on core engine performance and durability in "core-cendemonstrator engines in Project 4921 of this PE. Efforts are part of Versatile A demonstrator engines in Project 4921 of this PE. MAJOR THRUST: Design, fabricate, and demonstrate performance predictie engine cycles and advanced materials to provide greater durability, improved consumption for tur				PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER AND TITLE 681B Advanced Turbine Engine G Generator		Engine Gas
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
681B	Generator	26.662	34.279	56.624	69.118	44.387	32.141	30.238	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
efficie (U) <u>A</u> T v v p o d d a c c c n d d f f	nt embedded turbine engines, and small h A. Mission Description and Budget Item This project develops and demonstrates ter- veight, fuel consumption, and cost of owr erformance, cost, durability, reparability, f the engine and nominally consists of a con- emonstration validates engineering desig pplied to derivative and/or new systems. ombat vehicles, ships, and responsive spa- omponents (such as inlet systems, fans, la hanagement systems) on core engine perfer emonstration of adaptive cycle technolog uel efficiency, and durability for widely w	neavy fueled eng <u>n Justification</u> chnology to incr nership. The obj and maintainab compressor, a co n tools and enha These technolo ace launch. Com ow pressure turb formance and du nis PE. Efforts a gies, which deve varying mission	rease turbine er ective is to pro- ility can be ass ombustor, a hig unces rapid, low gies are applica ponent techno- pines, and exha rability in "cor re part of Vers lop component needs.	ngine operation wide continued essed in a reali- h-pressure turb v-risk transition able to a wide r logies are dem ust systems) ar e-centric engin atile Affordabl technology fo	al reliability, du l evolution of te istic engine env bine, mechanica n of key engine range of militar ionstrated in a c nd system level de dwanced Tu r an adaptive cy	urability, missi echnologies into ironment. The l systems, and technologies in y and commerce ore (sub-engine technologies (son. The core por bine Engines ycle engine arcl	on flexibility, o an advanced gas generator core subsyster no engineering ial systems in- e). This project such as integrated erformances of (VAATE). A nitecture that p	and performanc gas generator in r, or core, is the ms. Experiment g development, cluding aircraft, ct also assesses tted power gener f this project are portion of this p provides optimiz	e while reducin n which basic building b tal core engine where they can missiles, land impact of low s rators and thern e validated on project supports ted performance	ng block i be spool nal s the e,
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Design, fabricate, ar engine cycles and advanced materials to consumption for turbofan/turbojet engine cycle hypersonic cruise vehicles, and larg significant part of the Air Force's engine future aircraft engines, thus enabling new longer range and greater payloads for lon hardware fabrication and conduct engine In FY 2007: Completed detailed design advanced turbine blade materials incorpora and turbine heat loads, ceramic turbine co	(\$ in Millions) and demonstrate p provide greater of es for fighters, at ge transports. Es inventory and o of capabilities for ag range strike ca demonstrations and began fabric orating next gene omponents, and	performance producability, impl tack aircraft, b ach of these tec ffer potentially faster, surviva apability. Note evation of advan eration cooling systems for act	edictions in corroved performation ombers, sustain chnology innov significant per ble, durable, m : In FY 2009, ced core engin schemes, nove tive control, the	re engines, usin ance, and reduc- ned supersonic vations can be a rformance enha- nore responsive funding increas e technologies, el coatings to rea ermal managem	g innovative ed fuel and combined pplied to a ncements to systems with ed to complete including duce combusto nent, and power	E <u>v</u>	<u>Y 2007</u> 21.088	<u>FY 2008</u> 21.303	<u>FY 2009</u> 45.299
Proje	ct 681B			R-1 Line Iter Page-24	m No. 21 of 27				Exhibit R-2a (PE 0603216F)
				348	3					

	Exhibit R-2a, RDT&E Project Jus	DATE	DATE February 2008		
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology	PROJECT NUM 681B Advar Generator	IBER AND TITLE ICEd Turbine I	Engine Gas
(U)	B. Accomplishments/Planned Program (\$ in Millions) extraction. Completed preliminary design and risk reduction planning for a tip turb compression system, innovative annular combustor, and advanced rotating seals. D unique compression system components.	E ine concept, including a novel Designed and began fabrication of	<u>Y 2007</u>	<u>FY 2008</u>	FY 2009
(U)	In FY 2008: Complete fabrication and initiate instrumentation and assembly of advincluding advanced turbine blade materials incorporating next generation cooling second second turbine heat loads, ceramic turbine components, and systems for acting and power extraction. Complete detailed design and initiate fabrication for a tip tur compression system, innovative annular combustor, and advanced rotating seals. Cunique compression system components. Initiate preliminary design of high temper compressor, combustor, and turbine for sustained supersonic long range strike core	vanced core engine components, chemes, novel coatings to reduce ive control, thermal management, bine concept, including a novel complete design and fabrication of rature capable, durable engine.			
(U)	In FY 2009: Complete assembly and demonstration of advanced core engine comp turbine blade materials incorporating next generation cooling schemes, novel coatine turbine heat loads, ceramic turbine components, and systems for active control, there extraction. Complete fabrication and initiate performance demonstration of a tip tur- compression system, innovative annular combustor, and advanced rotating seals. C and experimental demonstration of unique compression system components. Comp temperature capable, durable compressor, combustor, and turbine for sustained supe engine.	onents, including advanced ags to reduce combustor and rmal management, and power rbine concept, including a novel complete fabrication, assembly blete preliminary design of high ersonic long range strike core			
(U) (U)	MAJOR THRUST: Design, fabricate, and demonstrate high overall pressure ration durability and affordability with lower fuel consumption for turbofan/turboshaft eng altitude unmanned air vehicles for persistent intelligence surveillance reconnaissance transports, subsonic Unmanned Air Systems (UAS), and powered munitions. Note: this effort has been increased due to emphasis on component development in suppor turbine engines and small heavy fueled engines.	cores to provide increased gines for long endurance high ce, intertheater/intratheater : In FY 2008 and out, funding in rt of highly efficient embedded	3.433	11.983	11.325
(U)	In FY 2007: Completed detailed design and initiated fabrication of core component concept with advanced core technologies including high efficiency, high pressure ra compressor, high efficiency, high heat release combustor, and high work, high cool integrated thermal management system and advanced mechanical systems. Complet of multi-Service heavy fuel engine technologies for future rotorcraft.	ts for highly efficient core engine atio, high temperature capability ing effectiveness turbine with an eted experimental demonstration			
(U) Proje	In FY 2008: Complete fabrication and initiate assembly of highly efficient core eng R-1 Line Page	gine components concept with Item No. 21 -25 of 27		Exhibit R-2a ((PE 0603216F)

	Exhibit R-2a, RDT&E Project Jus		DATE February 2008			
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603216F Aerospace Propulsion an Power Technology	PROJEC d 681B A Genera	T NUMBER AND TITLE	Engine Gas	
(U)	B. Accomplishments/Planned Program (\$ in Millions) advanced core technologies including high efficiency, high pressure ratio, high ten high efficiency, high heat release combustor, and high work, high cooling effective thermal management system and advanced mechanical systems. Create preliminar affordable advanced core engine technologies including an efficient high pressure combustor, and high performance turbine, and systems for thermal management and	perature capability compressor, ness turbine with an integrated y design of UAS small versatile compressor, a high heat release d advanced power extraction.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Complete assembly and demonstrate a highly efficient core engine constrained to the technologies including high efficiency, high pressure ratio, high temperature capability high heat release combustor, and high work, high cooling effectiveness turbine with management system and advanced mechanical systems. Initiate design of higher product preliminary design of core for highly efficient core engine concept with an including high efficiency, high pressure ratio, high temperature capability compress release combustor, and high work, high cooling effectiveness turbine with an integrand advanced mechanical systems. Complete design, initiate hardware fabrication reduction experimental demonstrations of UAS small versatile affordable advanced including a high heat release combustor, durable high performance turbine, and system advanced power extraction.	ncept with advanced core ility compressor, high efficiency, an an integrated thermal ressure ratio core components. dvanced core technologies sor, high efficiency, high heat rated thermal management system and continue selective risk core engine technologies tems for thermal management and				
(U) (U)	CONGRESSIONAL ADD: Versatile Affordable Advanced Turbine Engines (VA 681B).	ATE) (Note: only for project	2.141	0.000	0.000	
(U) (U)	In FY 2007: Identified and evaluated engine control issues and effects of rapidly of off the engine. Assessed viability of a new combustor configuration, an advanced advanced high pressure compressor rotor. In FY 2008: Not Applicable.	rawing large amounts of power surbine cooling concept, and an				
(U) (U)	In FY 2009: Not Applicable.					
(U) (U) (U)	CONGRESSIONAL ADD: Ceramic Matric Composite (CMC) Airfoil Capability I In FY 2007: Not Applicable. In FY 2008: This program will demonstrate CMC airfoil fabrication capability enh advanced aerospace gas turbines. Focus will be on design, fabrication, and testing In EV 2009: Not Applicable	Enhancements ancements for application to of critical airfoil sub-elements.	0.000	0.993	0.000	
(U)	Total Cost		26.662	34.279	56.624	
Proj	R-1 Line Page	Item No. 21 -26 of 27		Exhibit R-2a	(PE 0603216F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008
BUD 03 /	GET ACTIVITY Advanced Technology Develop		PE NUMBER AND TITLE 0603216F Aerospace Propulsion and Power Technology			PROJECT NUMBER AND TITLE 681B Advanced Turbine Engine Gas Generator			
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons</u>)						
		FY 2007 Actual	FY 2008 Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> Estimate	Cost to Complete <u>Total Cost</u>
(U) (U) (U) (U)	Related Activities: PE 0602201F, Aerospace Flight Dynamics. PE 0602203F, Aerospace Propulsion. PE 0603003A, Aviation Advanced Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.								
(U)	D. Acquisition Strategy Not Applicable.								
Pro	oject 681B			R-1 Line Page	e Item No. 21 e-27 of 27				Exhibit R-2a (PE 0603216F)
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PE NUMBER: 0603231F PE TITLE: Crew Systems and Personnel Protection Technology

	Exhib	DATE	February	2008						
BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603231F Crew Systems and Personnel Protection Technology										
	Cost (\$ in Millions)	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	Complete	l
	Total Program Element (PE) Cost	39.503	38.406	26.630	32.630	30.534	33.017	34.942	Continuing	TBD
2830	Decision Effectiveness Technology	26.580	29.420	18.295	23.906	22.205	23.588	25.724	Continuing	TBD
4924	Warfighter Readiness Technology	9.149	6.209	6.050	5.737	5.301	6.062	5.896	Continuing	TBD
5020	Bioeffects & Protection Technology	3.774	2.777	2.285	2.987	3.028	3.367	3.322	Continuing	TBD

Note: FY 2008 funding totals do not include \$0.3 million FY 2008 GWOT requirements still pending Congressional consideration. Funds for the FY 2008 Congressionally-directed Virtual Medical Trainer in the amount of \$2.4 million are in the process of being moved to the Defense Health Program from PE 0603231F, Crew Systems and Personnel Protection Technology, for execution.

(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 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 2008, Congress added \$1.0 million for Variable Transmittance Visor, \$2.4 million for Virtual Medical Trainer, \$1.6 million for Battlefield Automatic Life Status Monitor (BALSM), \$2.7 million for Low Cost/Improved Performance for Helmet Display and Life Support Technologies, and \$2.4 million for Water Purification with Fused Carbon Nanotube Nanostructured Material. 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 Bu	dget Item Justification		DATE Februa	ary 2008						
BUD		PE NUMBER AND TITLE	Porsonnol C	Protection Technolog	N V						
03 4	Advanced Technology Development (ATD)	000323 IF Crew Systems and	Personner		уу						
(U)	B. Program Change Summary (\$ in Millions)										
		F	<u>č</u> 2007	FY 2008	FY 2009						
(U)	Previous President's Budget		43.890	28.558	29.376						
Ú)	Current PBR/President's Budget		39.503	38.406	26.630						
Ú)	Total Adjustments		-4.387	9.848							
Ú)	Congressional Program Reductions										
Ì Í	Congressional Rescissions			-0.252							
	Congressional Increases			10.100							
	Reprogrammings		-3.518								
	SBIR/STTR Transfer		-0.869								
(U)	Significant Program Changes:										
Ì Í	Not Applicable.										
	C. Performance Metrics										
	Under Development.										
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		R-1 Line Item No. 22									
		Page-2 of 18		Exhibit F	R-2 (PE 0603231F)						
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	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008	
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BUDGE 03 Ac	ET ACTIVITY Ivanced Technology Development (ATD)		P 0 P	E NUMBER AND 603231F Crev Personnel Pro	TITLE w Systems a ptection Tech	nd Inology	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness gy Technology			
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
	Cost (\$ in Minions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
2830	Decision Effectiveness Technology	26.580	29.420	18.295	23.906	22.205	23.588	25.724	Continuing	TBD	
NT .	Quantity of RDT&E Articles			0		0	0				
Note: from F	Funds for the FY 2008 Congressionally-d PE 0603231E Crew Systems and Personne	Protection Te	Medical Traine	er in the amoun	it of \$2.4 millio	on are in the pro	cess of being	moved to the D	efense Health F	rogram	
T cc a v tu tu e s d	This project develops and demonstrates was ontrol, and mission execution in the emergi irmen to rapidly assimilate critical inform varfighter interface technologies that simp echnologies that enhance logistics function ffectiveness during aerospace and cyber of ystem technologies to support long duration lecision effectiveness in AF operations.	rfighter capabil ging network-en ation and make lify and speed c ns, improve the perations, supp on missions, and	ity enhancing t nabled operatio timely and cor critical operatio fidelity and ac- ort development d improve the r	echnologies an nal environmer rect decisions, ons in air operat curacy of large nt of novel, tail nanhunt capabi	nd information of nt. Included are display technol tion centers and -scale military so ored bio-taggan ilities of AF spe	operations tech e advanced tech logies and deci- l battle manage simulations, pr at and identifica- ecial operations	nologies that p nologies that sion aids that ment platform otect deployed ation/neutraliz s. The ultimat	promote effective improve the ab- enhance time-cr as. The project d personnel, imp- ation capabilities e goal is to assu	ve decision-mak ility of battlefie itical strikes, ar also develops prove human es, develop aircu ure warfighter	ring, Id Id	
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and demons and Intelligence, Surveillance and Recom- tailored decision support systems, guideling simulators and training systems, enhanced load and improve mission accomplishmer	(\$ in Millions) trate human-cen naissance (ISR) nes for effective l decision-maki nt.	ntered tools for communities. e selection of IG ng tools, and an	the Air Force Provide the IO D/ISR/Cyber w utomated tools	Information Op /ISR/Cyber wa /arriors, IO/ISR to reduce ever-	perations (IO) rrior with /Cyber .increasing data	E	<u>Y 2007</u> 2.778	<u>FY 2008</u> 1.682	<u>FY 2009</u> 2.685	
(U)	In FY 2007: Developed maturing IO/ISR information. Matured and developed IO c and techniques to improve operator perfor displays and enhanced exploitation for ISR operators.	tools, methods capabilities enha mance for ISR R operators. Be	, and technolog ancement techr planning and a egan to develop	y to gain, expl ology. Develo nalysis. Begar advanced train	oit, defend, and oped and demor n to develop ISF ning methodolo	l attack nstrated tools R optimal ogies and tools					
(U)	In FY 2008: Develop and demonstrate the development and demonstration of operat data overload. Expand IO/ISR training re missions. Develop Influence Operations to workload optimization development.	e utility and effor- or-aiding technologies and search and eval	ectiveness of IS ologies to explo uate new regin d facilitate tran	SR operator pla bit data from no nens to address sition into follo	unning tools. Co ew ISR sensors training for nev ow-on IO/ISR co	ontinue and reduce w ISR operator					
(U)	In FY 2009: Design advanced IO/ISR/Cy	ber technologie	es and demonst	rate next-gener	ation IO/ISR/C	by ber operator					
Proje	ct 2830			R-1 Line Iten Page-3 c	n No. 22 of 18				Exhibit R-2a (PE 0603231F)	

BUDGET ACTIVITY PE NUMBER AND TILE PROJECT AUMMER AND TILE 03 Advanced Technology Development (ATD) PE NUMBER AND TILE PROJECT AUMMERA AND TILE 04 Description B Accomplishments/flamed Prozent (\$ in Millions) FY 2007 FY 2008 FY 2007 workstation capabilities to operationally integrate/normalize AF non-kinetic capabilities with kinetic operations. Continue development. FY 2007 FY 2008 FY 2007 (U) MAJOR THRUST: Develop and demonstrate human effectiveness technologies to improve combat effectiveness reporting, situation assessment updates, and decision support for Combined Air and Space Operations. Centers (CAOC). 3.650 1.938 1.89 (U) In FY 2007: Commenced field tests of the visualization tools in an operational environment or exercise. Developed additional took, including spatial audio and voice-over-Internet-protocol communication, to allow more advanced collaboration within the strategy division and with other groups in the CAOC. In FY 2009: Integrated visualization tools with other collaborative tools to create a seamless flow of operational assessment data into strategy planning data. Demonstrate a final visualization tool strate for minula effective ensist is duration tool for rapid and actionable decision-making. 3.935 3.651 3.935 (U) In FY 2009: Integrated visualization tools with other collaborative tools to create a seamless flow of operational assessment data into strategy planning data. 3.935		Exhibit R-2a, RDT&E Project Jus	D	DATE February 2008				
(I) B. Accomplishments/Planned Program (\$ in Millions) FY 2007 FY 2008 FY 2008 (D) Workstation capabilities to operationally integrate/normalize AF non-kinetic capabilities with kinetic operations. FY 2007 FY 2008 FY 2008 (U) MAUOR THRUST: Develop and demonstrate human effectiveness technologies to improve combat effectiveness reporting, situation assessment updates, and decision support for Combined Air and Space Operations Centers (CAOC). 1.938 1.899 (U) In FY 2007: Commenced field tests of the visualization tools in an operational environment or exercise. Developed additional tools, including spatial audio and voic-over-Internet-protocol communication, to allow more advanced collaboration within the strategy division and with other groups in the CAOC. 1.972 1.938 1.899 (I) In FY 2007: Commenced field tests of the visualization tools in an operator field test results, develop enhancements that foster command level interaction with the visualization tool for rapid and actionable decision-making. 1.972 1.972 3.651 3.935 (I) In FY 2008: Develop and demonstrate technologies to interface between ground controllers assessment. Based on operator field test results, develop enhancements at find visually-oriented, unified strategy planning and assessment support tool in a simulation sculor timelines, reduced largeting and frainicide errors, and increased situational awareness of friend and foe in combat zones. Develop technologies premiting surevisory-Levi interfaces between ground controller-spec	BUDO 03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT I 2830 Dec Technolo	CT NUMBER AND TITLE Decision Effectiveness hology			
(U) MAJOR THRUST: Develop and demonstrate human effectiveness technologies to improve combat effectiveness reporting, situation assessment updates, and decision support for Combined Air and Space Operations Centers (CAOC). 1.938 1.89 (U) In FY 2007: Commenced field tests of the visualization tools in an operational environment or exercise. Developed additional tools, including spatial audio and voice-over-Internet-protocol communication, to allow more advanced collaboration within the strategy division and with other groups in the CAOC. 1.918 1.89 (U) In FY 2008: Develop a predictive analysis tool based on continuous and dynamic operational effects assessment. Based on operator field test results, develop enhancements that foster command level interaction with the visualization tools with other collaborative tools to create a scamless flow of operational assessment atta into strategy planning data. Demonstrate a final visually-oriented, unified strategy planning and assessment support tool in a simulated CAOC. 1.01 (U) MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple assessment support tool in a simulated CAOC. 3.935 3.651 3.93 (U) MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple assessment support is caster mission execution timelines, reduced targeting and fratricide errors, and increased situational awareness through positional awareness of friend and foe in combat zones. Develop technologies permitting supervisory-level interfaces between ground controller specific requirements leading to faster misision affield tests to quantify the decision-m	(U)	B. Accomplishments/Planned Program (\$ in Millions) workstation capabilities to operationally integrate/normalize AF non-kinetic capabil Continue development of operator-aiding and training tools for IO/ISR/Cyber opera influence development.	ities with kinetic operations. tors. Initiate advanced Cyber	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) MAJOR THRUST: Develop and demonstrate human effectiveness technologies to improve combat effectiveness 3.650 1.938 1.89 (C) MAJOR THRUST: Develop and decision support for Combined Air and Space Operations Centers 3.650 1.938 1.89 (C) In FY 2007: Commenced field tests of the visualization tools in an operational environment or exercise. Developed additional tools, including spatial audio and voice-over-Internet-protocol communication, to allow more advanced collaboration within the strategy division and with other groups in the CAOC. 10 In FY 2008: Develop a predictive analysis tool based on continuous and dynamic operational effects assessment. Based on operator field test results, develop enhancements that foster command level interaction with the visualization tools with other collaborative tools to create a seamless flow of operational assessment data into strategy planning data. Demonstrate a final visually-oriented, unified strategy planning and assessment data into strategy planning data. Demonstrate a final visually-oriented, unified strategy planning and assessment data into strategy planning data. Demonstrate conclusion timelines, reduced targeting and farticide errors, and increased situational awareness through positional awareness of friend and foe in combat zones. Develop technologies permitting supervisory-level interfaces between ground controllers and multiple. Support services entrolly operators. 3.935 3.651 3.93 (U) MAJOR THRUST: Develop and demonstrate technologies and field tests on quantify the decision-making benefits from advanced control/displays or completion develop eration and indivice crors, and increased situational awareness t	(U)							
 In FY 2007: Commenced field tests of the visualization tools in an operational environment or exercise. Developed additional tools, including spatial audio and voice-over-Internet-protocol communication, to allow more advanced collaboration within the strategy division and with other groups in the CAOC. In FY 2008: Develop a predictive analysis tool based on continuous and dynamic operational effects assessment. Based on operator field test results, develop enhancements that foster command level interaction with the visualization tool for rapid and actionable decision-making. In FY 2009: Integrated visualization tools with other collaborative tools to create a seamless flow of operational assessment dua into strategy planning data. Demonstrate a final visually-oriented, unified strategy planning and assessment support tool in a simulated CAOC. MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple 3.935 3.651 3.93 machine components through unified visual and auditory displays. Technologies address ground controller-specific requirements leading to faster mission execution timelines, reduced targeting and fratricide errors, and increased situational awareness through unified visual and foe in combat zones. Develop technologies permitting supervisor-level interfaces between ground controllers and multiple machine components are pound controllers and multiple, highly autonomous unmanned aerial vehicles (UAV). Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced components through unified visual and auditory displays. Demonstrated UAV interfaces featuring intelligent aceroph unified visual and auditory displays. Demonstrated UAV interfaces feature intelligent aceroph control for operation and auditory displays. Demonstrated user protocom demonstrate operator status reporting and wearable displays. Demonstrated user independent speech recognition and language	(U)	MAJOR THRUST: Develop and demonstrate human effectiveness technologies to reporting, situation assessment updates, and decision support for Combined Air and (CAOC).	improve combat effectiveness Space Operations Centers	3.650	1.938	1.891		
(U) In FY 2008: Develop a predictive analysis tool based on continuous and dynamic operational effects assessment. Based on operator field test results, develop enhancements that foster command level interaction with the visualization tool for rapid and actionable decision-making. (U) In FY 2009: Integrated visualization tools with other collaborative tools to create a scamless flow of operational assessment data into strategy planning data. Demonstrate a final visually-oriented, unified strategy planning and assessment support tool in a simulated CAOC. (U) MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple 3.935 3.651 3.93 machine components through unified visual and auditory displays. Technologies address ground controller-specific requirements leading to faster mission execution timelines, reduced targeting and fratricide errors, and increased situational awareness through positional awareness of friend and foe in combat zones. Develop technologies permitting supervisory-level interfaces between ground controllers and multiple, highly autonomous unmanned aerial vehicles (UAV). Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced control/display portrayal concepts that optimize net-centric information flow to system operators. (U) In FY 2007: Completed development and demonstration of advanced interface technologies between ground controllers and multiple machine components through unified visual and auditory displays. Demonstrated UAV interfaces featuring intelligent agent search patterns in the ground controller operational environment. Demonstrated operator headgear incorporating basic operator status reporting and wearable displa	(U)	In FY 2007: Commenced field tests of the visualization tools in an operational envi additional tools, including spatial audio and voice-over-Internet-protocol communic collaboration within the strategy division and with other groups in the CAOC.	ronment or exercise. Developed ation, to allow more advanced					
 (U) In FY 2009: Integrated visualization tools with other collaborative tools to create a seamless flow of operational assessment data into strategy planning data. Demonstrate a final visually-oriented, unified strategy planning and assessment support tool in a simulated CAOC. (U) MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple 3.935 3.651 3.93 machine components through unified visual and auditory displays. Technologies address ground controller-specific requirements leading to faster mission execution timelines, reduced targeting and fratricide errors, and increased situational awareness through positional awareness of friend and foe in combat zones. Develop technologies permitting supervisory-level interfaces between ground controllers and multiple, highly autonomous unmanned aerial vehicles (UAV). Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced control/display portrayal concepts that optimize net-centric information flow to system operators. (U) In FY 2007: Completed development and demonstration of advanced interface technologies between ground controllers and multiple machine components through unified visual and auditory displays. Demonstrated UAV interfaces featuring intelligent agent search patterns in the ground controller operational environment. Demonstrated operator headgear incorporating basic operator status reporting and wearable displays. Demonstrated user independent speech recognition and language translation customized for ground controller equipment and Terminal Attack Control (TAC) earplug microphones. 	(U)	In FY 2008: Develop a predictive analysis tool based on continuous and dynamic o Based on operator field test results, develop enhancements that foster command leve visualization tool for rapid and actionable decision-making.						
 (U) MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple 3.935 3.651 3.93 machine components through unified visual and auditory displays. Technologies address ground controller-specific requirements leading to faster mission execution timelines, reduced targeting and fratricide errors, and increased situational awareness through positional awareness of friend and foe in combat zones. Develop technologies permitting supervisory-level interfaces between ground controllers and multiple, highly autonomous unmanned aerial vehicles (UAV). Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced control/display portrayal concepts that optimize net-centric information flow to system operators. (U) In FY 2007: Completed development and demonstration of advanced interface technologies between ground controllers and multiple machine components through unified visual and auditory displays. Demonstrated UAV interfaces featuring intelligent agent search patterns in the ground controller operational environment. Demonstrated operator headgear incorporating basic operator status reporting and wearable displays. Demonstrated user independent speech recognition and language translation customized for ground controller equipment and Terminal Attack Control (TAC) earplug microphones. Project 2830 	(U)	In FY 2009: Integrated visualization tools with other collaborative tools to create a assessment data into strategy planning data. Demonstrate a final visually-oriented, assessment support tool in a simulated CAOC.	seamless flow of operational unified strategy planning and					
(U) MAJOR THRUST: Develop and demonstrate technologies to interface between ground controllers and multiple 3.935 3.651 3.93 machine components through unified visual and auditory displays. Technologies address ground controller-specific requirements leading to faster mission execution timelines, reduced targeting and fratricide errors, and increased 3.935 3.651 3.93 permitting supervisory-level interfaces between ground controllers and multiple, highly autonomous unmanned aerial vehicles (UAV). Employ real-time wargaming simulations and field tests to quantify the decision-making benefits from advanced control/display portrayal concepts that optimize net-centric information flow to system operators. (U) In FY 2007: Completed development and demonstration of advanced interface technologies between ground controllers and multiple machine components through unified visual and auditory displays. Demonstrated UAV interfaces featuring intelligent agent search patterns in the ground controller operational environment. Demonstrated operator headgear incorporating basic operator status reporting and wearable displays. Demonstrated user independent speech recognition and language translation customized for ground controller equipment and Terminal Attack Control (TAC) earplug microphones. R-1 Line Item No. 22 Project 2830 Exhibit R-2a (PE 0603231	(U)							
(U) In FY 2007: Completed development and demonstration of advanced interface technologies between ground controllers and multiple machine components through unified visual and auditory displays. Demonstrated UAV interfaces featuring intelligent agent search patterns in the ground controller operational environment. Demonstrated operator headgear incorporating basic operator status reporting and wearable displays. Demonstrated user independent speech recognition and language translation customized for ground controller equipment and Terminal Attack Control (TAC) earplug microphones. Project 2830 R-1 Line Item No. 22 Page-4 of 18 Exhibit R-2a (PE 0603231	(U)	MAJOR THRUST: Develop and demonstrate technologies to interface between gromachine components through unified visual and auditory displays. Technologies are requirements leading to faster mission execution timelines, reduced targeting and frasituational awareness through positional awareness of friend and foe in combat zone permitting supervisory-level interfaces between ground controllers and multiple, his aerial vehicles (UAV). Employ real-time wargaming simulations and field tests to a benefits from advanced control/display portrayal concepts that optimize net-centric operators.	ound controllers and multiple Idress ground controller-specific atricide errors, and increased es. Develop technologies ghly autonomous unmanned quantify the decision-making information flow to system	3.935	3.651	3.933		
R-1 Line Item No. 22 Project 2830 Page-4 of 18 Exhibit R-2a (PE 0603231	(U)	In FY 2007: Completed development and demonstration of advanced interface tech controllers and multiple machine components through unified visual and auditory di interfaces featuring intelligent agent search patterns in the ground controller operation operator headgear incorporating basic operator status reporting and wearable display independent speech recognition and language translation customized for ground corr Attack Control (TAC) earplug microphones.	anologies between ground isplays. Demonstrated UAV onal environment. Demonstrated ys. Demonstrated user atroller equipment and Terminal					
	Proj	ect 2830 R-1 Line Page	Item No. 22 -4 of 18		Exhibit R-2a	(PE 0603231F)		

	Exhibit R-2a, RDT&E Project Jus	Di	DATE February 2008				
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT N 2830 Dec Technolo	CT NUMBER AND TITLE Decision Effectiveness nology			
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Commence a spiral development to extend the capabilities of the adva	nced interface technologies that	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
	link ground controllers with multiple machine components through unified visual an	nd auditory displays.					
	improve speed and accuracy while offering a common situation display for Joint ser	vices interoperability. Provide					
	human factors design updates to battlefield air operations kit components, providing	faster setup and deployment of					
	micro-UAV as well as integrated power management for wearable components. De	monstrate user-independent					
	microphones. Begin hardware and software implementation of a supervisory control	l station technology baseline.					
	Begin concept development for a next-generation supervisory control station, and p	an to assess projected benefits in					
	terms of operator mission performance and overall usability relative to the technolog	gy baseline station.					
(U)	In FY 2009: Continue to develop and demonstrate human systems integration concerned other battlefield airmen. Demonstrate technologies for three dimensional audio nav	epts for ground controllers and					
	environments while improving team situational awareness by geo-location of voice	communications. Incorporate a					
	geo-located survival guide into a wearable computer, and demonstrate its value in a	n operationally relevant					
	environment. Develop and incorporate an advanced battlefield air traffic control ca	pability in the combat controller's					
	dynamic wartime scenario. Complete hardware and software implementation of a s	upervisory control station					
	technology baseline and a next-generation supervisory control station. Plan a technology	ology demonstration program					
	using real-time system simulation and field testing in spiral demonstration phases.	Establish the scope of simulation					
	and test activities, select experimental variables, determine key performance measur	res and commence the					
(U)	assessment.						
(U)	MAJOR THRUST: Develop and demonstrate decision-aiding technologies that ass	ist the Joint Forces Commander	0.970	1.843	2.225		
	(JFC)/Joint Forces Air Component Commander (JFACC) to rapidly assess the battle	efield situation, predict the most					
an	likely adversary behaviors, and select and prioritize the appropriate courses of action In EV 2007: Began first spiral development cycle of a decision aid that will support	n. global military operations by					
(0)	providing a common global picture, fully integrating military planning, operations, a	and supporting intelligence.					
	Enabled real-time reachback to operational and intelligence knowledge sources.						
(U)	In FY 2008: Complete the first spiral development of CPE decision aids and simula	ition based on global strike and					
	Expand the scope of the scenario-based cognitive work to include non-traditional w	arfare such as humanitarian relief					
Pro	ect 2830 R-1 Line Page	Item No. 22 -5 of 18		Exhibit R-2a	(PE 0603231F)		
	3	57					

	Exhibit R-2a, RDT&E Project Just	DA	DATE February 2008				
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT N 2830 Deci Technolog	ECT NUMBER AND TITLE Decision Effectiveness nology			
(U)	B. Accomplishments/Planned Program (\$ in Millions) and global war on terrorism. Begin a cognitive work analysis with this expanded sc	ope.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Integrate tools developed in first spiral into identified technology demo CPE decision aids and simulation tools in the technology demonstration environmer second spiral development cycle informed by the results of the technology demonstr and global war on terrorism emphases. Identify exercise to evaluate the expanded b aid tools and simulation. Plan a technology demonstration program.	onstration program. Evaluate the at. Refine tools and begin the ation with humanitarian relief enefits and utility of the decision					
(U)	I 6						
(U)	MAJOR THRUST: Develop and demonstrate advanced visual display technologies capability to reduce pilot workload and enhance mission performance. Note: In FY	to provide integrated day/night 2007, this effort was	0.242	0.000	0.000		
an	discontinued to align work with higher AF priorities.	tection in airborne displays					
(0)	In FY 2008: Not Applicable.	tection in an borne displays.					
(U)	In FY 2009: Not Applicable.						
(U)							
(U)	MAJOR THRUST: Develop and demonstrate novel, tailored bio-taggant and identic capabilities to meet specific AF needs to enhance force protection and enable air operations tempo	fication/neutralization erations commanders to maintain	1.137	1.493	1.552		
(U)	In FY 2007: Evaluated the capabilities of emerging aptamer technologies to enhance development of these DNA-based identification and neutralization technologies that reliable techniques for special forces to locate identify track and counter energy ac	e bio-taggant capabilities. Began will lead to affordable and tivities					
(U)	In FY 2008: Select the best emerging technologies for bio-taggant and threat neutral develop those technologies into fieldable counterproliferation capabilities. Aptamer used to enhance the effectiveness of the cold plasma and directed energy technologie attach quantum dots and mixed-metal nanoparticles to aptamers to serve as taggants	ization applications and begin to based technology will also be es. Develop the capability to for biological agents.					
(U)	In FY 2009: Further develop the selected technologies and refine application to mis incorporation of quantum dot and mixed-metal nanoparticle technologies. Develop insertion/distribution of bio-taggants in target areas.	sion need to include models of optimal					
(U)							
(U)	MAJOR THRUST: Develop and demonstrate intelligent software agents, realistic h behavior models, and advanced job performance aiding technologies. Computer age fidelity to large-scale synthetic environments and war games, and provide intelligen	uman and organizational ents and models add realism and ce analysts a way to model	3.538	4.490	1.166		
Proi	ect 2830 R-1 Line I Page	tem No. 22 6 of 18		Exhibit R-2a	(PE 0603231F)		
	3	58			· /		

	Exhibit R-2a, RDT&E Project Ju	DA	DATE February 2008				
BUDG 03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT N 2830 Deci Technolog	T NUMBER AND TITLE ecision Effectiveness blogy			
(U)	B. Accomplishments/Planned Program (\$ in Millions) collected data. Job aiding technologies provide command and control operators of manageable amount of multi-source critical information to avoid operator overloa decision-making during mobility operations. Note: Decreased emphasis in FY 2 demonstration effort in FY 2008.	with automated access to a ad and to support fast and accurate 2009 reflects completion of advanced	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2007: Began a series of critical experiments toward modeling a society as Transitioned work-centered collaborative planning and decision-making software Developed composable command and control (C2) human computer interface ele computer network into a rapidly reconfigurable C2 system. Conducted initial lab C2 modules.	a complex system of systems. e to the Air Mobility Command. ements that can be assembled via poratory experiments on composable					
(U)	In FY 2008: Continue to develop and experiment with system-of-systems societa complexity and degree of dynamic change. Expand development of work-center and decision-making software tools into the unstructured C2 work environment of re-synchronization. Investigate the value of implementing human-computer inter of an enterprise architecture.	al modeling, increasing the ed collaborative planning, analysis, of dynamic mission rfaces as services or as service layers					
(U)	In FY 2009: Continue to develop human behavior modeling of individuals and g Continue to experiment with system-of-systems societal modeling, using increase Demonstrate how information flows through and is modified by a society. Devel used as standards for evaluating different modeling approaches. Continue to eval modeling approaches.	groups in highly dynamic situations. ingly complex scenarios. lop design reference scenarios to be luate promising models and					
(U) (U)	MAJOR THRUST: Develop and demonstrate logistics technologies for improve improved system supportability. These technologies will improve the efficiency deployments and mobility operations in support of Agile Combat Support initiation concepts	d deployment operations and and effectiveness of AF ves and Air Expeditionary Force	1.965	1.221	0.895		
(U)	In FY 2007: Completed development and application of technology to automatic information required to effectively manage logistics resources in support of comb and development of very fast, easy-to-use dynamic planning/replanning capabilit to define coalition C2 information requirements to support cross-cultural plannin defining requirements for emergency response logistics needs.	cally collect and update critical bat operations. Completed design ies for adaptive logistics. Worked g and coordination. Began work on					
(U)	In FY 2008: Evaluate methods for organizational impact analysis of new inform support collaborative logistics. Collect human-centric performance data from critical d	nation and network-based tools to tical experiments and joint exercises					
Proj	ect 2830 R-1 Li	ne Item No. 22 age-7 of 18		Exhibit R-2a	(PE 0603231F)		

	Exhibit R-2a, RDT&E Project Just	D/	February	y 2008			
BUD(03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT N 2830 Dec Technolo	JECT NUMBER AND TITLE D Decision Effectiveness hnology			
(U)	B. Accomplishments/Planned Program (\$ in Millions) to benchmark improvements in maintenance, transportation, and supply functions in	contingency support.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Develop organizational-level change templates for effective application operations. Validate these change templates in operational settings (e.g., airlift cont centers) for effective implementation of advanced automation technologies.	ns of net-based logistics rol centers, logistics readiness					
(U) (U)	MAJOR THRUST: Develop and demonstrate cognitive-based analytic and design r tools for C2 operations to synchronize personnel in distributed locations with a share battlespace. Increasingly, C2 personnel operate in a complex information environm understanding and complicates operational decision-making. This decision support work-centered user interface concept having the potential to rapidly configure comn operations and streamline decision-making.	nethods and computer software ed understanding of the C2 ent that inhibits situation technology exploits an emerging non visualizations of C2	2.443	1.426	1.933		
(U)	In FY 2007: Began to analyze the work aiding requirements for specific distributed course of action development teams supporting global operations. Began to apply the concept to develop shared visualizations and decision support for synchronizing global distributed C2 resources such as for the dynamic management of air refugling operations.	C2 users, such as for rapid he work-centered user interface bal operations involving					
(U)	In FY 2008: Continue to analyze the work aiding requirements for specific distribute course of action development teams supporting global operations, to include coverage execution. Conduct experiments to test and evaluate the ability of the work-centered to provide effective visualizations and decision support for global C2 operations.	ted C2 users such as for rapid ge both for planning and d user interface services approach					
(U)	In FY 2009: Refine the methods and techniques to decrease the analysis, design and work-centered support services for global C2 operations. Demonstrate in a simulative geographically distributed personnel can develop a shared situation understanding of the C2 battlespace.	d development time of providing on of global C2 operations that					
(U)	and islanding of the 02 cuttospace.						
(U)	MAJOR THRUST: Develop and demonstrate human protective system technologie Technologies will improve aircrew comfort, resulting in increased performance. No discontinued to align work with higher AF priorities.	es for extended missions. hte: In FY 2008, this effort is	0.657	0.751	0.000		
(U)	In FY 2007: Researched optimizing seat system technologies to improve safety, con Developed and evaluated candidate seat system optimization technologies that reduce discomfort, while maintaining spinal alignment. Extended design concepts to ensur- aircrew population.	mfort, and performance. ce aircrew fatigue and e accommodation of the full					
Proj	ect 2830 R-1 Line I Page	Item No. 22 -8 of 18		Exhibit R-2a	(PE 0603231F)		
	3	60					

	Exhibit R-2a, RDT&E Project	DA	DATE February 2008				
BUDG 03 A	BET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technolog	PROJECT N 2830 Deci y Technolog	CT NUMBER AND TITLE Decision Effectiveness Nology			
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Validate system specification through testing of candidate seat system technologies to improve performance, safety, and candidate seat system optimization technologies.	system designs. Continue research and d comfort. Demonstrate performance of	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2009: Not Applicable.						
(U)	MAJOR THRUST: Develop and demonstrate technologies for improved for warfighter performance in known toxic environments, and the identification of Develop capabilities for real-time human monitoring in the field and the iden before the warfighters' health and combat effectiveness are compromised. De health status, visualization, risk assessment technologies, and intent of human is a continuation of previous work in PE 0602202F.	ce protection, the maintenance of peak of difficult-to-detect enemy threats. tification of toxic substance exposure evelop model-based threat awareness, n adversaries. Note: This major thrust	0.000	0.892	2.015		
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Begin development of detection technologies to identify kidney using streamlined, yet robust, assay procedures and biomarkers. Generate se algorithms that fuse varied biomarker data. Multiple specific biomarkers wil toxic exposure of deployed forces.	and liver organ selective degradation lection criteria and integration l allow for early detection of low level					
(U)	In FY 2009: Continue development of biomarker based detection technologi human biosample input in the field. Develop new concepts for lightweight m non-medical personnel for demonstration of the analysis and detection techni potentially threatening toxic exposures to warfighters to protect AF personne threat detection and exposure. Develop enhanced anthropometric visualization heterogeneous sensor data of potential adversaries.	es. Develop methods for collecting nonitoring devices that are operable by ques. These technologies will identify l. Develop predictive human models for on techniques that integrate					
(U)							
(U) (U) (U) (U)	CONGRESSIONAL ADD: Air Force Advanced Micro-Compression Sock (In FY 2007: Conducted Congressionally-directed effort for AFAMS. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	AFAMS).	0.975	0.000	0.000		
(U) (U) (U) (U)	CONGRESSIONAL ADD: Variable Transmittance Visor. In FY 2007: Conducted Congressionally-directed effort for Variable Transmitt In FY 2008: Conduct Congressionally-directed effort for Variable Transmitt	iittance Visor. ance Visor.	0.975	0.993	0.000		
Proj	ect 2830	-1 Line Item No. 22 Page-9 of 18		Exhibit R-2a	(PE 0603231F)		

	Exhibit R-2a, RDT&E Project	D	DATE February 2008				
BUDC 03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT N 2830 Dec Technolo	PROJECT NUMBER AND TITLE 2830 Decision Effectiveness Fechnology			
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Not Applicable.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	CONGRESSIONAL ADD: Phasor-Bird Helmet Tracker (previously titled New Display Technology).	tt Generation Helmet Tracking and	1.268	0.000	0.000		
(U) (U) (U)	In FY 2007: Conducted Congressionally-directed effort for Phasor-Bird Helme In FY 2008: Not Applicable. In FY 2009: Not Applicable.	et Tracker.					
(U) (U) (U)	CONGRESSIONAL ADD: Field Deployable Influenza Genotyping System. In FY 2007: Conducted Congressionally-directed effort for Field Deployable I	nfluenza Genotyping System.	0.975	0.000	0.000		
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U) (U) (U)	CONGRESSIONAL ADD: Low Cost/Improved Performance for Helmet Disp In FY 2007: Conducted Congressionally-directed effort for Low Cost Improve In FY 2008: Conduct Congressionally-directed effort for Low Cost/Improved Life Support Technologies.	lay and Life Support Technologies. d Performance Helmet Display. Performance for Helmet Display and	1.072	2.683	0.000		
(U) (U)	In FY 2009: Not Applicable.						
(U) (U) (U) (U)	CONGRESSIONAL ADD: Virtual Medical Trainer. In FY 2007: Not Applicable. In FY 2008: Conduct Congressionally-directed effort for Virtual Medical Train In FY 2009: Not Applicable.	ner.	0.000	2.384	0.000		
(U) (U) (U)	CONGRESSIONAL ADD: Battlefield Automatic Life Status Monitor (BALS) In FY 2007: Not Applicable.	M).	0.000	1.589	0.000		
(U) (U)	In FY 2009: Not Applicable.						
(U) (U)	CONGRESSIONAL ADD: Water Purification with Fused Carbon Nanotube N In FY 2007: Not Applicable.	Vanostructured Material.	0.000	2.384	0.000		
Proj	R-1 Line Item No. 22 roject 2830 Page-10 of 18 Exhibit R-2a (PE 0603231F)						

	Exhibit R-2a, RDT&E Project Justification								TE February 2008		
BUD 03 /	GET ACTIVITY Advanced Technology Develop	ment (ATD)			PE NUMBER A 0603231F C Personnel F	E NUMBER AND TITLE PROJE 603231F Crew Systems and 2830 Personnel Protection Technology Tech			JECT NUMBER AND TITLE 0 Decision Effectiveness hnology		
(U) (U) (U)	B. Accomplishments/Planned Pr In FY 2008: Conduct Congression Nanostructured Material. In FY 2009: Not Applicable.	cogram (\$ in Mil nally-directed eff	l lions) Fort for Water Pu	urification with 1	Fused Carbon Na	anotube		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	Total Cost							26.580	29.420	18.295	
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons)</u>								
(U) (U) (U) (U)	Related Activities: PE 0602202F, Human Effectiveness Applied Research. PE 0604706F, Life Support Systems. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>Actual</u>	<u>Estimate</u>	Estimate	<u>Estimate</u>	<u>Estimate</u>	Estimate	Estimate	Complete	<u>Total Cost</u>	
Pro	ject 2830			R-1 Line Page	e Item No. 22 e-11 of 18				<u>Exhibit R-2a (</u>	PE 0603231F)	
	Project 2830 Page-11 of 18 Exhibit R-2a (PE 0603231F) 363 UNCLASSIFIED										

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008	
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)		P 0 F	PE NUMBER AND TITLEPROJE0603231F Crew Systems and4924Personnel Protection TechnologyTechnology			PROJECT NUM 4924 Warfigh Technology	DJECT NUMBER AND TITLE 24 Warfighter Readiness chnology		
	Cost (\$ in Millions)	FY 2007 Actual	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	9.149	6.209	6.050	5.737	5.301	6.062	5.896	Continuing	TBD	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
	A. Mission Description and Budget Item Justification This project develops and demonstrates advanced training, simulation, and mission rehearsal technologies that will improve warfighter capabilities and mission readiness by enhancing operator and team performance skills. This effort includes the development of technologies that enable integration of computer models, live weapon systems, and weapon system simulators to portray the global battlespace, including all-weather, day/night flight operations, C2, force protection, and aerospace operations. This project develops and demonstrates advanced training and simulation technologies that will improve warfighter readiness by enhancing mission training and mission rehearsal capabilities. Development and effective use of the global battlespace requires advances in training systems and in interconnection, information, visual, and representation technologies. The resulting mission training and rehearsal capabilities will enhance the mission essential competencies of combat and combat support individuals and teams that comprise the aerospace force.										
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Advance aerospace a rehearsal. These computer agents and mo warfighters. Technologies will increase the qualification.	(\$ in Millions) nd organization dels will add re raining effective	al behavior mo alism operation eness and effici	odels for integr ns, C2, force pr iency, and decr	rated warfighter rotection, and a rease time to mi	training and ir base defense ssion	<u>F</u> Y	<u>7 2007</u> 2.974	<u>FY 2008</u> 3.088	<u>FY 2009</u> 2.692	
(U)	In FY 2007: Developed interface parame Developed a proof of concept joint close a exercise planning and analysis shells to er development time. Developed performan training environment. Performed a small- Initiated development of functional requir	ters to link DM air support scho nable a robust so ce measuremen footprint trainin ements for man	O mission trair olhouse simula cenario authori t/monitoring te ng demonstrationaging learning	ning centers and ation environming ng capability the chnologies and on in a persiste in distributed	d live training rate (ent. Developed (hat reduces train d methods for a (ent wargaming e (training context	anges. preliminary hing deployable environment. s.					
(U)	In FY 2008: Develop integrated methods environments. Develop and demonstrate support, and C2. Demonstrate interface a development of scenario authoring shells Develop integrated methods for evaluating performance and readiness. Finalize the of distributed training contexts.	for assessing an integrated readi nd training capa amenable for gu g the impact of levelopment of	nd tracking per ness assessmer ability between aiding training different levels functional requ	formance in live at for air-to-air. DMO and live and learning ir of fidelity in s irements for m	ve, virtual, and or, air-to-ground, e range exercise n virtual and live simulation envir nanaging learnin	constructive close air s. Continue e contexts. conments on ng in					
(U)	In FY 2009: Demonstrate adaptive trainin Develop common tools for mission planning	ng within DMO ing, briefing, an	using embedd d after action r	ed knowledge eview that fund	and skills assess ction across air	sment. combat,					
Proje	ect 4924			R-1 Line Iter Page-12	m No. 22 of 18				<u>Exhibit R-2</u> a (F	PE 0603231F)	
				364	1						

UDGET ACTIVITY PE NUMBER AND TITLE PR				
3 Advanced Technology Development (ATD) 0603231F Crew Systems and 49 Personnel Protection Technology Te	OJECT NUMBER AND TITLE 24 Warfighter Readiness chnology	CT NUMBER AND TITLE Warfighter Readiness lology		
J) B. Accomplishments/Planned Program (\$ in Millions) ground operations, and combat operations and planning in an AOC. Complete integration and evaluation of joint close air support (JCAS) environment for schoolhouse training. Demonstrate and validate technology alternatives for in-garrison and field deployable JCAS training and rehearsal system. Initiate development of specifications for integrating forward deployed battlefield coordination and command simulation with JCAS schoolhouse training. Demonstrate embedded training and performance assessment in a deployed combat training environment. Demonstrate integrated deployed DMO capability in large scale Live, Virtual, and Constructive (LVC) event. Demonstrate quantitative methods for certifying simulation fidelity and readiness training capabilities.	<u>007 FY 2008 I</u>	<u>FY 2009</u>		
 J) MAJOR THRUST: Develop a low-cost, deployable visual simulation system with sufficient image resolution and 1.1 performance capable of supporting the imaging of high-resolution fast-moving targets, high-density terrain, texture, surround imagery, and helmet-mounted sights. This technology will provide the warfighter realistic air-to-air and air-to-ground visual simulation environments to support aircrew training during expeditionary deployments and at mission training centers. U) In FY 2007: Began development of advanced, ultra resolution head-mounted and deployable Compact Immersive Visual Environment (CIVE) proof-of-concept display components. Began engineering and human factors analyses of the display components. 	142 1.276	1.192		
 J) In FY 2008: Continue engineering and human factors analyses of the CIVE display and image generation components to assess feasibility of new scanning architectures, image fidelity and stability, portability, resolution, size, weight, transport delay, and user acceptance. U) In FY 2009: Develop CIVE head-mounted and compact off-the-head display/image generation proof of concept component demonstrations. Begin human factors analyses and technology performance evaluations of the concept demonstrations. 				
 J) MAJOR THRUST: Develop and demonstrate training technologies and techniques to optimize night vision 0.7 device-aided night operations. These technologies could reduce the cost of Night Vision Goggle (NVG) qualification and increase combat capability. Note: In FY 2007, this effort terminated due to higher AF priorities. U) In FY 2007: Developed NVG simulator scenarios and related performance metrics for advanced NVG employment training. Developed geo-specific databases and database modification tools for desktop NVG visualization training. Test simulated panoramic NVG in DMO testbed. Developed untethered NVG simulation for NVG video and head position by application of broadband wireless technology. Demonstrated head position driven simulated NVG imagery viewable by multiple viewers in an open space. 	716 0.000	0.000		
Project 4924 R-1 Line Item No. 22 Page-13 of 18	Exhibit R-2a (PE (0603231F)		

	Exhibit R-2a, RDT&E Project J	ATE February 2008					
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT N 4924 War Technolo	NUMBER AND TITLE fighter Readine 999	IBER AND TITLE hter Readiness		
(U) (U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Not Applicable. In FY 2009: Not Applicable.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	MAJOR THRUST: Develop and demonstrate a high-fidelity DMO training and an Air and Space Operations Center (AOC). Link AOC operational mission req to develop team learning environments for AOC units. Develop and demonstrat Warfare (EW) training technologies for use with live-virtual-constructive trainin systems/capabilities and advanced sensor platforms and weapons systems. Thes and coalition warfighters with more realistic EW mission training and rehearsal represent 21st century threats, thereby increasing operational readiness and capa	rehearsal capability for operators in uirements and performance metrics e high-fidelity, interactive Electronic g networks for future threat e technologies provide AF, Joint, environments that accurately pility.	2.075	1.845	2.166		
(U)	In FY 2007: Developed a proof-of-concept multiteam competency-based training assessment system capability for the AOC. Developed initial competency-based conducted a proof-of-concept test of competency-based scenario training capability for the AOC.	g package with performance scenario selection guidelines and ity for operational planners.					
(U)	In FY 2008: Develop competency-based training requirements for team and fun plans divisions including IO and ISR teams. Develop optimum training and mis information simulation into AOC weapon systems planning tools. Survey instru- targeted training of mission-essential knowledge and skills and develop most cap Begin the design and development of architectures and hardware that integrate li- networked simulations. Begin the development of a simulation of an advanced f DMO application. Demonstrate guiding a single EW training illuminator on a li- fully integrated, computer-generated, and live forces.	ctional areas within strategy and sion rehearsal strategies to employ ctional methods for employment in pable method(s) for integration. ve EW range data into shared ighter-specific EW sensor suite for ve electronic combat range with					
(U)	In FY 2009: Develop integrated strategy and plans division trainer based on correquirements and optimum mission rehearsal strategies. Develop integration messystems and applications. Develop team, inter-team and division-level event spectraining and continuation training scenarios. Validate environment approaches t capture, and analysis to define quality of experience, spectrum of training capabilities. Complete live EW range integration into DMO. Develop a simulat EW sensor suite for DMO. Develop a proof-of-concept desktop system integrat with a synthetic threat environment featuring advanced missile fly out models are Begin measuring and validating improvements in EW training using these technology of methods for improved, embedded EW training capability on aird	npetency-based training thods for fielded and emerging cifications for mission qualification nrough exercise simulations, data lity, and performance assessment ion of an advanced platform-specific ng multiple EW suite simulations d basic directed energy threats. blogies and techniques. Begin the borne aircraft and design systems and					
Pro	ject 4924 R-1 L	ine Item No. 22 age-14 of 18		Exhibit R-2a	(PE 0603231F)		
		366					

	Exhibit R-2	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUDGET ACTIVITY 03 Advanced Technology I	Development (ATD)			PE NUMBER A 0603231F C Personnel A	ND TITLE Frew Systems Protection Tec	and chnology	PROJECT NUM 4924 Warfig Technology	IBER AND TITLE hter Readine	SS
(U) <u>B. Accomplishments/Pla</u> demonstrate these techno	anned Program (\$ in Mill logies during a live-fly exe	ions) ercise at an EW	training range.			I	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
 (U) (U) CONGRESSIONAL AD (U) In FY 2007: Conducted (U) In FY 2008: Not Applica 	D: Authentic Tactical Flig Congressionally-directed e able.	ht Simulator for fort for Auther	or JSF. ntic Tactical Flig	tht Simulator for	r JSF.		1.267	0.000	0.000
 (U) In FY 2009: Not Applica (U) (U) CONGRESSIONAL AD (U) In FY 2006: Conducted (U) In FY 2008: Not Applica (U) In FY 2009: Not Applica 	able. D: Database Integration T Congressionally-directed e able. able.	ools. ffort for Databa	ase Integration T	ools.			0.975	0.000	0.000
(U) (U) Total Cost							9.149	6.209	6.050
 (U) <u>C. Other Program Fund</u> (U) Related Activities: (U) PE 0602202F, Human Effectiveness Applied Res (U) PE 0604227F, Distributed Mission Training. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and elin duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. 	ing Summary (\$ in Millio <u>FY 2007</u> <u>Actual</u> search.	<u>ns)</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>
R-1 Line Item No. 22 Project 4924 Page-15 of 18 S67								(PE 0603231F)	

	ExI	hibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)		F C F	PE NUMBER AND 0603231F Crev Personnel Pro	TITLE w Systems a ptection Tech	nd nology	PROJECT NUME 5020 Bioeffe Technology	BER AND TITLE cts & Protect	ion
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5020	Bioeffects & Protection Technology	3.774	2.777	2.285	2.987	3.028	3.367	3.322	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project integrates and demonstrates te or mission effectiveness, and man-portable laser eye protection (LEP), preventing inju enabling operational employment of these systems and technologies to enhance perso demonstrated to enable sustained and enha	echnologies to p e technologies for rious exposures systems. It also onnel safety and nced operations	rovide protection or the neutralization of personnel in develops tools effectiveness in in extreme environment	on against dire ation of threats nvolved with to and guideline n aerospace op vironments to i	cted energy three s. Development est and evaluations for testing and perations. Biobe- include surge, n	eats and hazarda and demonstration on of high power d deploying high thavioral perfor- ight, global, inf	s, without con ation efforts for er microwave gh power micr rmance capabi formation war	npromising perf ocus on advance or high-energy owave and high ilities are develo fare, C2, and ot	ormance, vigila d technologies laser weapons, -energy laser oped and her operations.	ance, for and
(U) (U) (U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and demonst to provide protection against any laser has In FY 2007: Completed development of second-generation LEP goggles for Speci compatibility. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	(\$ in Millions) strate multiwave zard or threat in integrated eye p al Operations ai	length LEP tec a single device rotection techn r and ground fo	chnologies for e. Note: This ologies. Demo orces, assessin	aircrew and gro effort completed onstrated and de g human factors	und personnel d in FY 2007. elivered and mission	<u>F</u> Y	<u>¥ 2007</u> 0.572	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U)	MAJOR THRUST: Develop and demons energy laser weapons and systems.	strate technologi	es that permit	safe testing, de	eployment, and	use of high		0.782	0.902	0.875
(U) (U) (U)	In FY 2007: Combined modeling and exp airborne laser wavelength and other near- combined exposures when compared to the In FY 2008: Release laser range safety so function to support live fire test of major software package Continue assessment o In FY 2009: Complete validation, verific collateral hazard assessment software too	perimental meas infrared laser be neir single-wave oftware tool incl systems. Initiat f probabilistic ri ation, and accre l to enable analy	surement of add earns to define length counter uding dynamic e validation, ve sk assessment ditation packag vsis of tactical t	litional multip the relative dat parts. bi-directional erification, and for use with la ge for laser ran uses for high-e	le-wavelength e mage thresholds reflectivity dist accreditation p user hazard asses age safety tool. energy laser syst	exposures to s of the tribution ackage for new ssment. Release ems.	,			
(U) (U)	MAJOR THRUST: Develop and demons	strate technologi	es to assess bio	beffects and pr	otection from ra	dio frequency		0.000	0.882	1.142
Proje	ect 5020			R-1 Line Iter Page-16	m No. 22 of 18 3				Exhibit R-2a (PE 0603231F)

	Exhibit R-2a, RDT&E Project Jus	tification	DA	February	/ 2008
BUD(03 A	GET ACTIVITY Idvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603231F Crew Systems and Personnel Protection Technology	PROJECT N 5020 Bioe Technolo	UMBER AND TITLE Iffects & Protec gy	tion
(U)	B. Accomplishments/Planned Program (\$ in Millions) (RF) systems, including terahertz technologies. Note: This major thrust is a continu	uation of previous work in PE	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
a n	0602202F.				
(U)	In FY 2007: Not Applicable.	-in a maliation to management			
(0)	In FY 2008: Initiate program to develop solutions for both laser and other non-ionic Integrate laser solutions into solutions for RF, microwave, terahertz, and other regin for personnel protection.	nes of electromagnetic radiation			
(U)	In FY 2009: Continue to develop laser and RF and other non-ionizing protective so Develop bioeffects-based fire-control algorithms for directed energy weapons. Con protective technologies with those for RF, microwave, terahertz, and other regimes personnel protection. Establish preliminary design specifications for directed energy Continue long-term studies of RF weapon systems effects	lutions for personnel protection. tinue integration of laser of electromagnetic radiation for y protective equipment.			
(U)	continue tong term studies of Re ⁺ weapon systems effects.				
(U)	MAJOR THRUST: Develop and demonstrate ability to support testing of counterforman-portable threat neutralization capabilities.	orce technologies and to enable	0.823	0.635	0.268
(U)	In FY 2007: Refined and downselected neutralization devices, developed simulant integrated with threat detection technologies. Demonstrated most promising man-p	testing capabilities, and ortable threat neutralization			
(U)	In FY 2008: Begin developing technologies that will provide the capability to neutrine evidence for special applications. Develop technologies to enable safe return and ave other equipment.	ralize threats without leaving void contaminating aircraft or			
(U)	In FY 2009: Continue development of technologies that will provide the capability evidence for special applications. Improve technologies to enable safe return and av other equipment.	to neutralize threats without void contaminating aircraft or			
(U)					
(U)	MAJOR THRUST: Develop a fatigue management capability to alleviate the negat performance in aerospace operations. Results will extend and enhance human perfor- sustained and continuous (24/7) mission environments for all aviation, C2, special of space operators. Note: This effort completes in FY 2008.	ive effects of fatigue on human ormance and survivability in operations, maintenance, and	0.622	0.358	0.000
(U)	In FY 2007: Integrated biobehavioral performance model for selected military task scheduling and special forces mission planning.	s, such as airlift/tanker crew			
(U)	In FY 2008: Complete development and demonstrate quantitative biobehavioral pe	rformance management tools to			
	R-1 Line	Item No. 22			/
Pro	ect 5020 Page	1/ of 18		Exhibit R-2a	(PE 0603231F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DA	February	/ 2008	
BUD(03 A	GET ACTIVITY Advanced Technology Developm	nent (ATD)			PE NUMBER AND TITLEPROJECT0603231F Crew Systems and5020 EPersonnel Protection TechnologyTechnology				CT NUMBER AND TITLE Bioeffects & Protection hology		
(U) (U)	B. Accomplishments/Planned Pro provide scheduling solutions and op performance in sustained and contir In FY 2009: Not Applicable.	gram (\$ in Mil berational risk m nuous (24/7) mil	lions) nanagement calc litary operations	culations to extens.	nd and enhance	human		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
 (U) (U) (U) (U) (U) (U) (U) 	CONGRESSIONAL ADD: Full Sp In FY 2007: Conducted Congression In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ectrum Laser E onally-directed e	ye Protection. effort for Full Sp	pectrum Laser E	ye Protection.			0.975	0.000	0.000	
(U) (U)	Total Cost							3.774	2.777	2.285	
(U)	C. Other Program Funding Summ	ary (\$ in Millio	ons)								
		<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) (U) (U) (U) (U) (U)	PE 0602102F, Materials. PE 0602202F, Human Effectiveness Applied Research. PE 0603112F, Advanced Materials for Weapon Systems. PE 0603319F, Airborne Laser Program. PE 0604706F, Life Support Systems. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.										
Pro	ject 5020			R-1 Line Page	e Item No. 22 e-18 of 18 370				Exhibit R-2a	(PE 0603231F)	

PE NUMBER: 0603270F PE TITLE: Electronic Combat Technology

Exhib	Exhibit R-2, RDT&E Budget Item Justification								
BUDGET ACTIVITY 03 Advanced Technology Development (A	ATD)		PE 0	E NUMBER AND	TITLE tronic Comb	at Technolog	JY .		
Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Total Day survey Element (DE) Coast	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	TDD
2432 Defensive System Eusion Technology	6 186	20.702	21.050	16.740	18.312	23.009	<u> </u>	Continuing	TBD
431G RF Warning & Countermeasures Tech	8 643	7.691	6 788	5 946	5 269	6 860	8.065	Continuing	TBD
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$									
 Note: Funds for the FY 2008 Congressionally-directed Innovative Polymeric Materials for Three-Dimensional (3-D) Microdevice Construction in the amount of \$1.0 million are in the process of being moved from PE 0603270F, Electronic Combat Technology, to PE 0602102F, Materials, for execution. FY 2008 funding totals do not include \$5.325 million in FY 2008 GWOT requirements still pending Congressional consideration. (U) <u>A. Mission Description and Budget Item Justification</u> This program develops and demonstrates technologies to support Air Force electronic combat warfighting capabilities. The program focuses on developing components, subsystems, and technologies for integrating electronic combat sensors and systems into a fused and seamless whole. The second project develops and demonstrates technologies for radio-frequency (RF) electronic combat suites. The third project develops and demonstrates advanced technologies for radio-frequency (RF) electronic combat suites. Note: In FY 2008 Congress added \$1.7 million for Advanced Threat Alert Advanced Technology Development and \$1.5 million for BLADES. This program is in Budget Activity 3, Advanced Technology Developments that have 									

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

			<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget		28.528	23.743	21.287
(U)	Current PBR/President's Budget		27.599	26.762	21.056
(U)	Total Adjustments		-0.929	3.019	
(U)	Congressional Program Reductions			-0.004	
	Congressional Rescissions			-0.177	
	Congressional Increases			4.200	
	Reprogrammings		-0.288	-1.000	
	SBIR/STTR Transfer		-0.641		
(U)	Significant Program Changes:				
	Not Applicable.				
		R-1 Line Item No. 23			
		Page-1 of 11		Exhibit F	R-2 (PE 0603270F)

Exhibit R-2, RDT&E B	udget Item Justification	DATE February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Tee	chnology
C. Performance Metrics		
Under Development.		
	R-1 Line Item No. 23 Page-2 of 11	Exhibit R-2 (PE 0603270F)

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDGE 03 Ad	T ACTIVITY Ivanced Technology Development (A	ATD)		P 0 T	YE NUMBER AND 1603270F Elec Technology	o TITLE Ctronic Comb	pat	PROJECT NUME 2432 Defensi Technology	BER AND TITLE ive System F	usion
	Exhibit R-2a, RDT&E Project Justification Date February 2000 JDGET ACTIVITY 3 Advanced Technology Development (ATD) PE NUMBER AND TITLE 0603270F Electronic Combat Technology PROJECT NUMBER AND TITLE 2432 Defensive System Fusion Technology Cost (\$ in Millions) FY 2007 Actual FY 2008 FY 2008 Quantity of RDT&EK Articles FY 2010 0 FY 2011 FY 2010 Quantity of RDT&EK Articles FY 2010 0 FY 2010 0 FY 2010 0 FY 2011 FY 2012 Quantity of RDT&EK Articles Cost to 0 To 0 Cost to 0 To 0 Project and the provided the provide the					Total				
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	February 2 February 2 PROJECT NUMBER AND TITLE 2432 Defensive System Fu: Technology FY 2013 Cost to Estimate Complete 7 6.532 Continuing 0 0 0 . It develops advanced algorithm vironments. It also matures on, and suppression of adversary loff jammer technologies; and Y 2007 FY 2008 0.836 0.000 5.350 5.361		
2432	Defensive System Fusion Technology	6.186	7.050	5.878	4.907	5.623	8.627	6.532	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
T a tu d e	This project develops and demonstrates tec nd assessment techniques needed to evalu echnologies required for command-and-co lefense operations. Technologies included lectronic collection methods to inform fiel	hnologies for ir ate and enable on ntrol warfare, s are: advanced d commanders	tegrating elect combat aircraft tandoff jammin components an of changes in t	ronic combat s operations in r ng, and electron nd techniques r he electronic e	ensors and elec multi-spectral the nic support mean needed to jam e environment.	tronic combat shreat and count asures for the do nemy radars; ad	system fusion. ermeasure env enial, disruptio dvanced stand	It develops ad vironments. It a on, and suppress off jammer tech	vanced algorith lso matures sion of adversar nologies; and	ms y air
(U) (U) (U) (U) (U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and integrate completes in FY 2007. In FY 2007: Completed risk reduction for awareness in the Air Force Integrated Der Demonstrations and Applications Laborat network electronic attack techniques on di digital receiver and processor technologie threat response for current and next genera In FY 2008: Not Applicable. In FY 2009: Not Applicable.	(\$ in Millions) e advanced sens r defensive sens nonstrations and ory risk reductions sparate platform s that provide that ation aerospace	for receiver and ors using multi 1 Applications on evaluations ns. Performed ne warfighter w platforms.	l processing te iple informatio Laboratory. C and demonstra demonstration vith multispect	chnologies. No on sources for si completed Integ ations that evolv as of advanced 1 ral warning, ide	ote: This effort ituational rated ve and optimize nultiplatform entification, and	E)	<u>7 2007</u> 0.836	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U)	MAJOR THRUST: Develop affordable ra techniques. Develop techniques for coord defense systems. Conduct integrated elec for the deception and defeat of integrated In FY 2007: Completed brassboard demo	adio-frequency lination and mar tronic warfare a air defense syst nstration of adv	and electro-opt nagement of m nd information em threats. ranced threat al	ical emitter wa ultiple jammin operations sir ert and jammin	arning concepts g nodes against nulations and d ng subsystem fo	and t integrated air emonstrations or combat		5.350	5.361	5.878
(U)	aircraft to increase survivability against ac defense systems. Performed final flight te digital threat warning and response capabi In FY 2008: Complete maturation demon aircraft to increase survivability against ac	lvanced, integra ests to validate a lity. stration of adva lvanced, integra	tted radio-frequ dvanced jamm nced threat ale tted radio-frequ	iency, electro- ing techniques rt and jamming iency, electro-(optical, and infi s for a significan g subsystem for optical, and infi	rared air ntly improved combat rared air				
Proje	ct 2432			R-1 Line Iter Page-3 c	m No. 23 of 11 3				Exhibit R-2a (I	PE 0603270F)

BUDGET ACTIVITY PE NUMBER AND TILE PROJECT NUMBER AND TILE 03 Advanced Technology Development (ATD) 0632370F Electronic Combat Technology PROJECT NUMBER AND TILE 04 Channel Schumerts/Planned Program (\$ in Millions) EY 2002 EY 2002 EY 2008 EY 04 defense systems. Investigate electronic warfare battle management strategies and technical protocols for control of multiple jamming nodes working in coordination against an integrated air defense system in the overall context of non-traditional intelligence, surveillance, recomassance, and srike operations. Develop and demonstrate technical protocols for the integration of electronic warfare, and information operations against an integrated air defense system. No			Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
(U) E. Accomplishments/Planned Program (5 in Xillions) EY 2007 EY 2008 EX (U) E. Accomplishments/Planned Program (5 in Xillions) EY 2007 EY 2008 EX (U) In Figuration of deletronic warfare buttle management strategies and technical protocols for ontional in an integrated air defense system in the overall context of non-traditional intelligence, surveillance, recommand-and-control warfare, and information operations against an integrated air defense system. In Figuration of electronic warfare, and information operations against an integrated air defense system. In Figuratica in definition operations against an integrated air defense system. In Figuratica in definition operations against an integrated air defense system. In Figuratica in definition operations against an integrated air defense system. In Figuratica in definition figuratica in the context duratica. In Figuratica in definition figuratica context duratica. In Figuratica in definition figuratica context duratica. In Figuratica context duratica. In Figuratica. In Figuratica. </th <th>BUD(03 A</th> <th>GET ACTIVITY dvanced Technology Developn</th> <th>nent (ATD)</th> <th></th> <th></th> <th>PE NUMBER A 0603270F E Technology</th> <th>ND TITLE lectronic Com /</th> <th>ıbat</th> <th>PROJECT NUM 2432 Defens Technology</th> <th>IBER AND TITLE sive System F</th> <th>usion</th>	BUD(03 A	GET ACTIVITY dvanced Technology Developn	nent (ATD)			PE NUMBER A 0603270F E Technology	ND TITLE lectronic Com /	ıbat	PROJECT NUM 2432 Defens Technology	IBER AND TITLE sive System F	usion
 (1) In FY 2009: Conduct analyses and initial demonstrations of electronic warrare batter magement strategies in the Air Force Integrated Demonstrations and Applications Laboratory and Virtual Combat Laboratory simulation facilities. Continue to develop and demonstrate technical protocols for the integration of electronic warfare, command-and-control warfare, and information operations against an integrated air defense system. Develop and mature key technologies essential for Airborne Electronic Attack risk reduction. (U) CONGRESSIONAL ADD: Advanced Threat Alert Advanced Technology Development. (U) In FY 2008: Conduct Congressionally-directed effort for Advanced Threat Alert Advanced Technology Development. (U) In FY 2009: Not Applicable. (U) Total Cost (U) C.Other Program Funding Summary (\$ in Millions) EY 2007 EY 2008 EY 2009 EY 2010 EY 2011 EY 2012 EY 2013 Cost to Complete Total Estimate Estimate Estimate Estimate Complete Total (U) Related Activities: (U) PE 0603203F, Advanced Acrospace Sensors. (U) PE 0603203F, Advanced Acrospace Sensors. (U) PE 0603203F, Electronic Warfare Strate Strate Montonic Strate Str	(U)	B. Accomplishments/Planned Pro defense systems. Investigate electric multiple jamming nodes working in non-traditional intelligence, surveil protocols for the integration of elect an integrated air defense system.	ogram (\$ in Mil onic warfare ba o coordination a lance, reconnais tronic warfare, o	llions) ttle managemen gainst an integra ssance, and strik command-and-c	t strategies and to ated air defense s te operations. De control warfare, a	echnical protoco system in the over evelop and demo and information	ols for control of erall context of onstrate technica operations again	l st	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) (U) CONGRESSIONAL ADD: Advanced Threat Alert Advanced Technology Development. (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Advanced Threat Alert Advanced Technology Development. (U) In FY 2009: Not Applicable. (U) (U) Total Cost 6.186 7.050 (U) C. Other Program Funding Summary (\$ in Millions) EY 2007: FY 2008: FY 2009: FY 2010: FY 2011: FY 2012: FY 2013: Cost to Actual Estimate Estimate Estimate Estimate Estimate Complete (U) (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. (U) PE 0603203F, Advanced Acrospace Sensors. (U) PE 0603203F, Advanced Advanced Advanced Advanced Advanced Advanced Space Technology. (U) PE 0604270F, Electronic Warfare (EW) Development. (U) This project has been 	(U)	Air Force Integrated Demonstration facilities. Continue to develop and command-and-control warfare, and mature key technologies essential for	anitial demonst as and Applicati demonstrate tec information op or Airborne Ele	rations of electr ons Laboratory chnical protocol erations against ctronic Attack r	and Virtual Com s for the integrat an integrated air isk reduction.	the management abat Laboratory ion of electronic defense system	strategies in the simulation warfare, . Develop and				
(U) Total Cost 6.186 7.050 5 (U) C. Other Program Funding Summary (\$ in Millions) EY 2007 FY 2008 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Total (U) Related Activities: Actual Estimate Estimate Estimate Estimate Complete Total (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. Omplete Total (U) PE 0603203F, Advanced Aerospace Sensors. Advanced Space Technology. V) PE 0604270F, Electronic Warfare (EW) Development. Warfare (EW) Development. Exhibit R-2a (PE 060 Project 2432 Project 2432 R-1 Line Item No. 23 Exhibit R-2a (PE 060	(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Advan In FY 2007: Not Applicable. In FY 2008: Conduct Congressiona Development. In FY 2009: Not Applicable.	0.000	1.689	0.000						
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</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 Complete</u> <u>Total</u> (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603200F, Multi-disciplinary Advanced Space Technology. (U) PE 0604270F, Electronic Warfare (EW) Development. (U) This project has been 	(U)	Total Cost							6.186	7.050	5.878
 (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. (U) PE 0603203F, Advanced Aerospace Sensors. (U) PE 0603500F, Multi-disciplinary Advanced Space Technology. (U) PE 0604270F, Electronic Warfare (EW) Development. (U) This project has been Project 2432 R-1 Line Item No. 23 Page-4 of 11 Exhibit R-2a (PE 060	(U)	C. Other Program Funding Summ	<mark>nary (\$ in Milli</mark> <u>FY 2007</u> Actual	<u>ons)</u> <u>FY 2008</u> Estimate	FY 2009 Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimate	FY 2013 Estimate	<u>Cost to</u> Complete	Total Cost
R-1 Line Item No. 23 Project 2432 Page-4 of 11 Exhibit R-2a (PE 060	(U) (U) (U) (U) (U) (U)	Related Activities: PE 0602204F, Aerospace Sensors. PE 0603203F, Advanced Aerospace Sensors. PE 0603500F, Multi-disciplinary Advanced Space Technology. PE 0604270F, Electronic Warfare (EW) Development. This project has been									
	Pro	ect 2432			R-1 Line Page	Item No. 23 e-4 of 11				Exhibit R-2a ((PE 0603270F)

Exhibit R-2a, RD	DT&E Project Justification	DATE February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 2432 Defensive System Fusion Technology
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. (U) <u>D. Acquisition Strategy</u> Not Applicable. 		
Project 2432	R-1 Line Item No. 23 Page-5 of 11 	Exhibit R-2a (PE 0603270F)

	Exh	nibit R-2a, F	RDT&E Pro	ject Justifi	cation			DA	TE February 2	2008
BUDGE 03 Ac	ET ACTIVITY Ivanced Technology Development (/	ATD)		P 0 T	E NUMBER AND 603270F Elec echnology	TITLE ctronic Comb	at	PROJECT NL 431G RF V Counterme	IMBER AND TITLE Varning & easures Tech	
	Cost (\$ in Millions)	FY 2007	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total
431G	RF Warning & Countermeasures Tech	8.643	7.691	6.788	5.946	5.269	<u>6.860</u>	8.00	65 Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0		0	
(U) <u>A</u> T P a f i a	A. Mission Description and Budget Item. This project develops and demonstrates advorted by a structure of the second seco	Justification vanced technolo najor area addre s, and expert so tion of subsyste ntermeasures te	ogies for radio- esses technolog ftware for appl ems and compo echniques as we	frequency elect ies for missile/t ications on exis- onents for gener ell as advanced	tronic combat s threat warning, sting and future rating on-board electronic cour	uites to enhance radio-frequence electronic com /off-board radio ntermeasures te	e the survivab y receivers, el bat systems. p-frequency co chnologies su	ility of aeros lectronic com Another maj puntermeasur ch as antenna	pace vehicles and t abat pre-processors or technology area re techniques. This as, power amplifier	to s, s rs,
(U) (U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop wide-band, n (i.e., threat detection, threat avoidance, sup This effort completes in FY 2008. In FY 2007: Tested critical subsystems of compatible with unmanned aerial vehicles In FY 2008: Complete integration and tes In FY 2009: Not Applicable.	(\$ in Millions) multi-mode, mu ppression of en- f an efficient, lo a. st of array comp	ulti-function ap emy air defense ow-frequency, v patible with unr	ertures for elec es, surveillance wide-band aper nanned aerial v	tronic warfare a e, and reconnais ture, and fabric rehicles.	applications sance). Note: ate array	<u>F</u> Y	<u>7 2007</u> 1.425	<u>FY 2008</u> 1.148	<u>FY 2009</u> 0.000
(U) (U) (U)	MAJOR THRUST: Develop aerospace pl counter advanced radio-frequency threats coordinated, multi-player radar jamming t surveillance networks to enable all-platfor attack techniques fusing advanced digital a In FY 2007: Continued developing self-pr missile systems. Completed laboratory an techniques against advanced target engage techniques and technology to defeat an ad techniques and technologies for advanced support cross-cueing capabilities of a multi interference and platform compatibility to	atform self-pro associated with echniques for d m operations in signal processin rotection counte d field-testing e ement radars. C vanced integrat radio-frequenc ti-intelligence s provide precisi	tection and sup current and fu leception and n defended advo ng receivers wi ermeasures effo of innovative, r Completed deve ed air defense s y sensor system ensor suite incl ion location and	pport jamming t ture aerospace eutralization of ersary airspace. th digital techn ective against a networked radio elopment of adv system. Contin ns. Completed luding the effect d identification	technologies an weapon system early warning Develop new ique generators dvanced future o-frequency couv anced counterr ued developing demonstration ets of electroma with increased	d techniques to as. Develop and electronic surface to air intermeasure neasures g anti-jam of electronic gnetic probability of		6.222	6.543	6.788
Proje	ct 431G			R-1 Line Item Page-6 c 376	n No. 23 of 11				Exhibit R-2a (F	PE 0603270F)

BUDGET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND TITLE 03 Advanced Technology Development (ATD) 003270F Electronic Combat Technology PROJECT NUMBER AND TITLE (U) B. Accomptishments/Planned Program (\$ in Millions) FY 2007 FY 2007 FY 2008 FY 2009 FY 2011 FY 2012 FY 2013 Coast to (U) If Y			Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
U) B. Accomplishments/Planned Program (\$ in Millions) EY 2007 FY 2008 FY 2008 (U) In FY 2008: Provide hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Conduct threat research, simulation, and analysis of early warning radar characteristics. Develop multiple technical strategies and techniques for deceiving them in a network enabled operational environment. Develop advanced simulation exploiting to support network enabled imming of adversary early warning and surveillance networks. Develop advanced radar jamming engineering models including technique generators, wide-hand amplifier modules and apertures, needed to conduct network enabled research and evaluatie integrated digital receiver/jammer acchitectures. 0.996 0.000 0.00 (U) In FY 2009: Continue to provide hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Develop advanced radar jamming engineering models including technique generators, wide-hand amplifier modules and apertures, needed to conduct network enabled research and evaluatie integrated digital receiver/jammer brassboard architectures that leverage real-time electronic surveillance networks. Continue to develop advanced simulation and processing to enhance electronic attack effectiveness. 0.996 0.000 0.00 (U) In FY 2008: Not Applicable. 0.996 0.000 0.00 (U) In FY 2009: Not Applicable. 0.996 0.000 0.00 (U) Total Cost	BUD(03 A	GET ACTIVITY Advanced Technology Developr	ment (ATD)			PE NUMBER A 0603270F E Technology	ND TITLE lectronic Com /	ıbat	PROJECT NUM 431G RF Wa Countermea	BER AND TITLE Irning & Isures Tech	
 In FY 2008: Provide hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Conduct threat research, simulation, and analysis of ardy warning radar characteristics. Develop advanced simulation capabilities to support network enabled jamming of adversary early warning and surveillance networks. Develop and evaluate integrated digital receiver/jammer architectures. (U) In FY 2009: Continue to provide hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Develop advanced radar jamming engineering models including technique generators, wide-band amplifier modules and apertures, needed to conduct network enabled research and evaluation of countermeasure techniques. Continue to develop advanced simulation capabilities to support network enabled research and evaluation of countermeasure techniques. Continue to develop advanced simulation capabilities to support network enabled jamming of adversary early warning and surveillance entworks. Develop advanced simulation capabilities to support network enabled jamming of adversary early warning and surveillance entworks. Continue to develop and evaluate integrated digital receiver/ammer bravesboard architectures that leverage real-time electronic surveillance estimated of content electronic attack effectiveness. (U) In FY 2007: Conducted Congressionally-directed effort for RAPCEval. (U) In FY 2008: Not Applicable. (U) Total Cost (U) Related Activities: (U) PE 6003204F, Acrospace Sectors (U) PE 60042704F, Electronic Warfare (EW) Development. (U) PE 60042704F, Electronic Warfare (EW) Development. (U) PE 60	(U)	B. Accomplishments/Planned Pre	<u>ogram (\$ in Mil</u>	<u>lions)</u>				I	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009: Continue to provide hardware simulation and analysis support to multi-intelligence sensor needs for accurate and timely electronic surveillance information. Develop advanced radar jamming engineering models including technique generators, whice-band amplifter modules and apertures, needed to conduct network enabled irrespeated high-and amplifter modules and apertures. Readed to conduct network enabled irrespeated high receiver/jammer brassboard architectures that leverage real-time electronic surveillance signal processing to enhance electronic attack effectiveness. 0.996 0.000 0.00 (U) CONGRESSIONAL ADD: Receiver and Processing Concepts Evaluation (RAPCEval). 0.996 0.000 0.00 (U) CONGRESSIONAL ADD: Receiver and Processing Concepts Evaluation (RAPCEval). 0.996 0.000 0.00 (U) In FY 2008: Not Applicable. 0.996 0.000 0.00 (U) In FY 2008: Not Applicable. 0.996 0.000 0.00 (U) Total Cost 8.643 7.691 6.7 (U) Total Cost 8.643 7.691 6.7 (U) Total Cost 8.643 7.691 6.7 (U) Related Activities: Estimate Estimate Estimate Estimate Complete Total C (U) PE 60602204F, Aerospace Sensors.	(U)	Intercept. In FY 2008: Provide hardware sim timely electronic surveillance infor characteristics. Develop multiple t operational environment. Develop adversary early warning and survei architectures.	nulation and anal rmation. Conduc echnical strategi advanced simul illance networks	lysis support to a ct threat research es and techniqu ation capabilitie . Develop and e	multi-intelligenc n, simulation, an es for deceiving es to support netv evaluate integrate	e sensor needs f d analysis of ear them in a netwo work enabled jar ed digital receive	or accurate and ly warning radar ork enabled nming of er/jammer	r			
(U) CONGRESSIONAL ADD: Receiver and Processing Concepts Evaluation (RAPCEval). 0.996 0.000 0.0 (U) In FY 2007: Conducted Congressionally-directed effort for RAPCEval. 0 1 In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 0 96 0.000 0.0 (U) In FY 2009: Not Applicable. 0 8.643 7.691 6.7 (U) Total Cost 8.643 7.691 6.7 (U) Total Cost 8.643 7.691 6.7 (U) Total Cost 8.643 7.691 6.7 (U) Related Activities: Total C Cost to Total C (U) Related Activities: Complete Total C Complete Total C (U) PE 0602204F, Aerospace Sensors. Sensors. U) PE 0604270F, Electronic Warfare (EW) Development. U) PE 0603500F, Multi-disciplinary Advanced Space Technology. R-1 Line Item No. 23 Project 431G Page-7 of 11 Exhibit R-2a (PE 06032	(U)	In FY 2009: Continue to provide h accurate and timely electronic surv including technique generators, wie research and evaluation of countern support network enabled jamming evaluate integrated digital receiver, signal processing to enhance electr	hardware simulat reillance informa de-band amplific measure techniqu of adversary ear /jammer brassbo ronic attack effec	tion and analysis tion. Develop a er modules and a ues. Continue to ly warning and s ard architecture ctiveness.	s support to mult advanced radar ja apertures, needed o develop advand surveillance netw s that leverage re	ti-intelligence se amming enginee d to conduct network ced simulation c works. Continue eal-time electror	ensor needs for ering models work enabled apabilities to e to develop and nic surveillance				
 (b) In FY 2007. Conducted Congressionally-diffected enormor for KAPCEVal. (c) In FY 2008: Not Applicable. (d) Total Cost (e) Total Cost (f) C. Other Program Funding Summary (\$ in Millions) FY 2007. FY 2008. FY 2009. FY 2010. FY 2011. FY 2012. FY 2013. Cost to Cost to Actual Estimate Estimate Estimate Estimate Estimate Complete (f) Related Activities: (l) PE 0602204F, Aerospace Sensors. (l) PE 0604270F, Electronic Warfare (EW) Development. (l) PE 0603500F, Multi-disciplinary Advanced Space Technology. 	(U) (U)	CONGRESSIONAL ADD: Receiv	ver and Processi	ng Concepts Ev	aluation (RAPC	Eval).			0.996	0.000	0.000
(U) Total Cost 8.643 7.691 6.7 (U) C. Other Program Funding Summary (\$ in Millions) Total Cost	(U) (U) (U)	In FY 2009: Not Applicable. In FY 2009: Not Applicable.	ionany-unected (Eval.						
C. Other Program Funding Summary (\$ in Millions) FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Total C Actual Estimate Estimate Estimate Estimate Estimate Complete Total C U Related Activities: PE 0602204F, Aerospace Sensors. PE 0604270F, Electronic Warfare (EW) Development. PE 0603500F, Multi-disciplinary Advanced Space Technology. R-1 Line Item No. 23 Page-7 of 11 Exhibit R-2a (PE 06032	(U) (U)	Total Cost							8.643	7.691	6.788
FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Actual Total C (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. Estimate Estimate Estimate Estimate Estimate Estimate Complete Total C (U) PE 0602204F, Aerospace Sensors. (U) PE 0604270F, Electronic (U) PE 0603200F, Multi-disciplinary (U) PE 0603500F, Multi-disciplinary (U) PE 0603500F, Multi-disciplinary (U) Project 431G Exhibit R-2a (PE 06032	(U)	C. Other Program Funding Summ	<u>nary (\$ in Milli</u>	ons)							
 (U) Related Activities: (U) PE 0602204F, Aerospace Sensors. (U) PE 0604270F, Electronic Warfare (EW) Development. (U) PE 0603500F, Multi-disciplinary Advanced Space Technology. R-1 Line Item No. 23 Project 431G Exhibit R-2a (PE 06032 			FY 2007 Actual	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> Complete	Total Cost
(U) PE 0604270F, Electronic Warfare (EW) Development. (U) PE 0603500F, Multi-disciplinary Advanced Space Technology. R-1 Line Item No. 23 Project 431G Page-7 of 11 Exhibit R-2a (PE 06032)	(U) (U)	Related Activities: PE 0602204F, Aerospace Sensors									
(U) PE 0603500F, Multi-disciplinary Advanced Space Technology. R-1 Line Item No. 23 Project 431G Page-7 of 11 Exhibit R-2a (PE 06032	(U)	PE 0604270F, Electronic Warfare (EW) Development.									
R-1 Line Item No. 23 Project 431G Page-7 of 11 Exhibit R-2a (PE 06032	(U)	PE 0603500F, Multi-disciplinary Advanced Space Technology.									
	Pro	ject 431G			R-1 Line Page	Item No. 23 e-7 of 11				Exhibit R-2a	(PE 0603270F)

Exhibit R-2a, RDT&E P	roject Justification	DATE February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT NUMBER AND TITLE 431G RF Warning & Countermeasures Tech
 (U) C. Other Program Funding Summary (\$ in Millions) (U) PE 0604270N, EW Development. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. (U) D. Acquisition Strategy Not Applicable. 		
Project 431G	Page-8 of 11 378	Exhibit R-2a (PE 0603270F)

Exh	ibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDGET ACTIVITY 03 Advanced Technology Development (A	TD)		P 0 T	E NUMBER AND 603270F Elec echnology	TITLE	pat	PROJECT NUME 691X EO/IR V Countermea	BER AND TITLE Warning & sures Tech	
Cost (\$ in Millions)	FY 2007 Actual	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	12.770	12.021	8.390	5.887	7.420	10.122	9.527	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		
 This project develops and demonstrates the sacrospace platforms. Off-board (decoys and affordable solutions for protection against in tracking systems used to direct electro-optic B. Accomplishments/Planned Program (advanced warr l expendables) afrared missiles al, infrared, an	ing and counte and on-board with autonom d radar-guided	ermeasure tech countermeasure nous seekers, m l missiles.	nologies require e technologies c aulti-spectral thr	ed to negate ele leveloped for a reats, laser-guio	ectro-optical, in ircraft self-pro- led weapons, a	nfrared, and lass otection will pro- and electro-opti	er threats to ovide robust, cal and infrared	EV 2000
 (U) <u>B. Accomplishments/Planned Program (</u> (U) MAJOR THRUST: Analyze the vulnerabi sensors. (U) In EV 2007: Continued conducting in here 	5 in Millions) lities of curren	t infrared miss	ile systems and	l future imaging	g infrared	<u>F3</u>	1.862	<u>FY 2008</u> 3.687	<u>FY 2009</u> 4.565
(U) In FY 2007: Continued conducting in-not susceptibilities. Further evaluated countern infrared sensors. Conducted digital simula imaging infrared missiles under fly-out cor defeat imaging infrared sensors.	neasure techni tions to assess aditions. Asses	ques for count the effectivene sed proposed a	ering multiple ess of spatial de advanced coun	types of missile ecoy techniques termeasure tech	against niques to				
(U) In FY 2008: Conclude in-house analyses of susceptibilities. Further evaluation of cour- imaging infrared sensors. Identify optimal sensors	on infrared-guid ntermeasure tec countermeasur	led missile and hniques for co re techniques t	l future imagin ountering multij o defeat single	g infrared senso ple types of mis color imaging i	or siles and infrared				
 (U) In FY 2009: Perform laboratory analyses of current and planned techniques against new requirements. Conduct digital simulations techniques. 	on future infrar w threat trends to assess effec	ed guided miss and direction of tiveness of exp	sile capabilities of future counte pendable and la	s. Assess effect ermeasure techn user countermea	iveness of ique sure				
 (U) (U) MAJOR THRUST: Develop aerospace las acquisition/tracking sensors, including dete (laser-guided ordnance) signals. 	er warning sen ecting and loca	sor technologi ting both high	es for timely al power (dazzle/	lert to advanced damage) and lo	l laser w power		1.629	0.862	0.942
(U) In FY 2007: Initiated development of adva Continued developing laser warning sensor	anced laser was technologies	ning receiver f to address eme	for integration a rging laser three	into tactical airceats. Initiated m	craft. niniature laser				
Project 691X			R-1 Line Iten Page-9 c	n No. 23 of 11				Exhibit R-2a (F	PE 0603270F)

	Exhibit R-2a, RDT&E Proj	ect Justification	D/	February	/ 2008
BUD(03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603270F Electronic Combat Technology	PROJECT N 691X EO/ Countern	UMBER AND TITLE IR Warning & neasures Tech	
(U)	B. Accomplishments/Planned Program (\$ in Millions) warning for personnel protection.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Continue developing laser warning sensors to address emerge miniaturized laser warning sensors. Fabricate compact device for personal geolocate laser threats for enhanced situational awareness.	ging laser threats. Initiate development of nel protection. Demonstrate capability to			
(U)	In FY 2009: Continue developing laser warning sensors to address emerg miniaturized laser warning sensors. Fabricate sensor for sensor and eye p cue agile filters for optimized protection against advanced laser threats.	ging laser threats. Continue development of protection cueing. Demonstrate capability to			
(U) (U)	MAJOR THRUST: Develop a countermeasure technology to defeat pass tracking sensors and ordnance guidance	ive electro-optical and infrared aircraft	5.271	5.101	2.883
(U)	In FY 2007: Continued field tests to locate and counter passive threats be solution. Initiated development of a tower demonstration system. Demor regard and locate passive surveillance sensors in real time.	efore threats can develop a fire control nstrated capability to scan wide field of			
(U)	In FY 2008: Complete field tests to locate and counter passive threats bet solution. Complete tower demonstration system development and conduc effectiveness of countermeasure techniques against night vision devices a	fore threats can develop fire control ct experiments over 2 km range. Evaluate nd other passive surveillance sensors.			
(U)	In FY 2009: Initiate development of affordable, lightweight infrared cour surveillance and missile defeat techniques for tactical aircraft. Initiate development fy threats.	ntermeasures capability combining passive sign of a compact system to geolocate and			
(U)	MAIOP THRUST: Develop electro ontical/infrared missile warning tech	phologies to alert aircraws and aircraft	0.820	0.880	0.000
(0)	self-protection systems to the approach of advanced, low-signature threat	s. Note: This effort ends in FY 2008.	0.020	0.000	0.000
(U)	In FY 2007: Completed tests and evaluation of the affordable visible mis	sile warning system.			
(U)	In FY 2008: Characterize sensor performance in varied background clutter	er. Identify maximum detection ranges for			
	high priority threat missiles.				
(U)	In FY 2009: Not Applicable.				
(U) (U)	CONCRESSIONAL ADD: Affordable Visible Missile Worning System		1 902	0.000	0.000
(0)	In EV 2007: Conducted Congressionally-directed effort for the Affordab	le Visible Missile Warning System	1.895	0.000	0.000
(0)	In FY 2008: Not Applicable.	ie visible wissile warning bystem.			
(U)	In FY 2009: Not Applicable.				
		R-1 Line Item No. 23			
Pro	ect 691X	Page-10 of 11		Exhibit R-2a	(PE 0603270F)
		380			

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUD 03 /	GET ACTIVITY Advanced Technology Develop	ment (ATD)			PE NUMBER AND TITLEPROJEC0603270F Electronic Combat691X ITechnologyCount				CT NUMBER AND TITLE EO/IR Warning & termeasures Tech		
(U)	B. Accomplishments/Planned P	rogram (\$ in Mil	<u>lions)</u>				F	<u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
 (U) (U) (U) (U) (U) (U) 	CONGRESSIONAL ADD: Battle In FY 2007: Conducted Congress In FY 2008: Conduct Congression In FY 2009: Not Applicable.	efield Laser Detectionally-directed of nally-directed of nally-directed eff				1.295	1.491	0.000			
(U) (U)	Total Cost							12.770	12.021	8.390	
(U) (U) (U) (U) (U) (U) (U) (U)	C. Other Program Funding Sum Related Activities: PE 0602204F, Aerospace Sensors. PE 0604270F, Electronic Warfare (EW) Development. PE 0603500F, Multi-disciplinary Advanced Development Space Technology. PE 0604270N, EW Development. PE 0603203F, Advanced Aerospace Sensors. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>mary (\$ in Milli</u> <u>FY 2007</u> <u>Actual</u>	ons) 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>	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>	
Pro	ject 691X			R-1 Line Page	e Item No. 23 e-11 of 11				Exhibit R-2a ((PE 0603270F)	
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PE NUMBER: 0603311F PE TITLE: Ballistic Missile Technology

	Exhib	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUD 03	GET ACTIVITY Advanced Technology Development (/	ATD)		PE 0	E NUMBER AND 603311F Ball	TITLE	Technology			
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ III Millions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	9.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	47.294
409	1 Missile Electronics	9.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	47.294
Note	e: In FY 1997, the Air Force eliminated this	s program. How	vever, Congres	s has added fur	nds for Congres	ssionally-direct	ed efforts from	FY 1997-2007		
(U)	A. Mission Description and Budget Item	Justification								
	This program develops, integrates, and den instrumentation. This program is in Budge upgrades and/or new system developments	nonstrates advar t Activity 3, Ad that have milita	nced guidance, wanced Techno wry utility and a	navigation, and blogy Developr address warfigh	d control techno nent, since it do ter needs.	ologies for ball evelops and der	istic missiles, in monstrates tech	ncluding upgra nologies for ex	des for range sa disting system	afety
(U)	B. Program Change Summary (\$ in Mil	<u>lions)</u>								
							<u>FY 2007</u>	<u>FY 2</u>	<u>2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget						9.365	0	.000	0.000
(U)	Current PBR/President's Budget						9.128	0	.000	0.000
(U)	Total Adjustments						-0.237	0	.000	
(U)	Congressional Program Reductions									
	Congressional Rescissions									
	Congressional Increases									
	Reprogrammings						0.005			
	SBIR/STIR Transfer						-0.237			
(U)	In FY 1997, the Air Force eliminated this	program. Howe	ever, Congress	has added fund	ls for Congress	ional-directed	efforts since FY	7 1997.		
	C. Performance Metrics(U) Under Development.									
				R-1 Line Item Page-1 d	n No. 24 of 3				Exhibit R-2 (PE 0603311F)
				383						
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	Ext	nibit R-2a, R	DT&E Pro	ject Justifi	ication			DATE	February	2008
BUD(03 A	GET ACTIVITY Advanced Technology Development (A	ATD)		P 0 T	E NUMBER AND 603311F Ball echnology	TITLE listic Missile		PROJECT NUMI 4091 Missile	BER AND TITLE Electronics	
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
409	Missile Electronics	9.128	0.000	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		
(U)	A. Mission Description and Budget Item This program develops, integrates, and den instrumentation. This program is in Budge upgrades and/or new system developments	Justification nonstrates advar et Activity 3, Ad that have milita	nced guidance, vanced Techno ry utility and a	navigation, an ology Develop address warfigh	d control techno ment, since it do nter needs.	ologies for balli evelops and der	istic missiles, nonstrates tec	including upgra hnologies for ex	ides for range sa xisting system	afety
(U) (U) (U) (U) (U) (U)	B. Accomplishments/Planned Program CONGRESSIONAL ADD: Ballistic Miss In FY 2007: Conducted Congressionally- In FY 2008: Not Applicable. In FY 2009: Not Applicable.	(\$ in Millions) sile Technology directed effort f	/Minuteman II for Minuteman	I. III.			<u>FY</u>	3.884	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Pacific Ballis In FY 2007: Conducted Congressionally- In FY 2008: Not Applicable. In FY 2009: Not Applicable.	stic Missile Tecl directed effort f	nnology Progra for Pacific Ball	um. istic Missile To	echnology Prog	gram.		1.166	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: P-Net. In FY 2007: Conducted Congressionally- In FY 2008: Not Applicable. In FY 2009: Not Applicable.	directed effort f	or P-Net.					2.330	0.000	0.000
(U) (U) (U) (U)	CONGRESSIONAL ADD: Forward Base In FY 2007: Conducted Congressionally- In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ed Conventiona directed effort f	l Strike. or Forward Ba	sed Conventio	nal Strike.			1.748	0.000	0.000
(U)	Total Cost							9.128	0.000	0.000
Pro	ject 4091			R-1 Line Iten Page-2	n No. 24 of 3				Exhibit R-2a (I	PE 0603311F)
				384						

		DATE	DATE February 2008							
BUD 03 /	GET ACTIVITY Advanced Technology Develop	oment (ATD)			PE NUMBER A 0603311F B Technology	ND TITLE allistic Missile /		PROJECT NUME 4091 Missile	ER AND TITLE	
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	ons)							
		FY 2007 Actual	FY 2008 Estimate	<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>	Total Cost
(U) (U) (U)	Related Activities: PE 0602204F, Aerospace Sensors. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate									
(U)	duplication. D. Acquisition Strategy Not Applicable.									
Pro	oject 4091			R-1 Line Paç	e Item No. 24 ge-3 of 3				Exhibit R-2a (PE 0603311F)
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PE NUMBER: 0603401F PE TITLE: Advanced Spacecraft Technology

	Exhil	bit R-2, RDT	「&E Budge	t Item Just	tification			DATE	February	2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)					PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology					
	Cost (\$ in Millions)	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total		
	Total Program Element (PE) Cost	105.422	100.600	0 80.958	84.853	89.247	92.093	90.001	Continuing	g TBD
2181	Spacecraft Payloads	31.200	31.483	24.997	23.420	23.987	21.840	21.716	Continuing	TBD
3834	Integrated Space Technology Demonstrations	35.108	30.313	29.305	33.473	33.988	36.839	36.218	Continuing	TBD
4400 Space Systems Protection 3.440 4.923 7.866 9.472 11.633 10.294							9.246	.246 Continuing	g TBD	
5021	Space Systems Survivability	4.452	4.831	5.175	5.229	5.431	5.380	5.342	Continuing	TBD
5083	Ballistic Missiles Technology	2.990	5.806	5.649	5.179	5.429	6.259	6.077	Continuing	TBD
682J	Spacecraft Vehicles	28.232	23.244	7.966	8.080	8.779	11.481	11.402	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 2008, Congress added \$1.8 million for Small Low Cost Reconnaissance Spacecraft; \$2.4 million for Micromachined Switches for Next Generation Modular Satellites; \$1.6 million for Microsatellite Serial Manufacturing; \$2.0 million for Satellite Coherent Optical Receiver (SCORE); \$1.2 million for Space Situational Awareness; \$2.4 million for Systematic Approach to Radiation Hardened Electronics (SHARE); \$1.6 million for Intelligent Free Space Optical Satellite Communications Node; \$1.6 million for Radially Segmented Launch Vehicle (RSLV) Risk Reduction Program; \$2.0 million for COTS Technology for Situational Awareness; \$4.3 million for Large Automated Production of Expendable Launch Structures (LAPELS); and \$3.2 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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	Exhibit R-2, RDT&E Bud		DATE Februa	nry 2008	
BUD0 03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft	Fechnology		
(U)	B. Program Change Summary (\$ in Millions)				
		<u>FY 200</u>	<u>07</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget	101.1	15	78.704	85.838
(U)	Current PBR/President's Budget	105.42	22	100.600	80.958
(U)	Total Adjustments	4.30	07	21.896	
(U)	Congressional Program Reductions			-1.543	
	Congressional Rescissions			-0.661	
	Congressional Increases			24.100	
	Reprogrammings	6.13	82		
	SBIR/STTR Transfer	-1.8	75		
(U)	Significant Program Changes:				
	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. 25 Page-2 of 23		Evhihit E	
		200			100034017)

	Exi	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDGI 03 Ac	ET ACTIVITY Ivanced Technology Development (ATD)		F C 1	PE NUMBER AND D603401F Adv Fechnology	anced Space	ecraft	PROJECT NUME 2181 Spacec	BER AND TITLE raft Payloads	6
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ in Minons)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
2181	Spacecraft Payloads	31.200	31.483	24.997	23.420	23.987	21.840	21.716	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
r s t I c	This project funds the development, demon dvanced satellite surveillance operations, systems. Improved space-qualifiable elect near-term, this project's work concentrates systems. For mid-term applications, the In echnologies with commercially-derived, of Defense satellites. In the long-term, this pro- constellations of intelligent satellites capab	nstration, and ev and development ronics and softwork on converting (nproved Space Copen system arch roject area focus ole of performin	aluation of rad at of advanced vare for data an i.e., radiation-h Computer Prog hitectures to de ses on developing g all mission re	liation-hardene laser commun d signal proce hardening) com ram will mergy velop and dem ng low-cost, e elated function	ed space electron ications technol essing will be me nmercial data ar e advanced, rad nonstrate robust, easily modifiable s without operation	nic hardware, s logies to support ore interchange ad signal process iation-hardened on-board process e software and tor intervention	atellite contro rt next generat able, interope ssor technolog d space proces essing capabil hardware arch	l hardware and s tion satellite con rable, and stand- ies for use in Ai sor, memory, an ities for 21st cen itectures for full	software for nmunications ardized. In the ir Force space ad interconnect ntury Departme ly autonomous	ent of
(U) (U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop spacecraft r ultra-high density strategically hardened r and micro-electro-mechanical systems (M In FY 2007: Completed engineering mod general-purpose processor. Fabricated a l use in space and designed a very low-pow miniaturized military Global Positioning Fabricated the building blocks for a very	(\$ in Millions) nicroelectronic of nemories, space IEMS) compone lel of the high p high performance ver ADC using a System (GPS) ro high performance	devices, includ -qualifiable, hi ents and applic erformance 500 ee design harde idvanced desig eceiver for use ece ten million-g	ing radiation-h igh density adv ations.) million instru- ned analog-to- n cells and des on terrestrial, i gate design har	hardened data provention per secon digital converters sign hardening. aero, and space	rocessors and ng technology, ad er (ADC) for Fabricated the platforms. grammable gate	<u>F)</u>	<u>¥ 2007</u> 12.481	<u>FY 2008</u> 11.564	<u>FY 2009</u> 12.470
(U) (U)	In FY 2008: Initiate capabilities to the cu form a "push-button toolflow" satellite bu standardized data messages protocols from In FY 2009: Complete capabilities to the to form a "push-button toolflow" satellite allocating standardized data messages pro-	irrent Satellite D nilder. Initiate ra n sensors for ea current Satellite builder. Demon otocols from sen	Design Automat adiation-harder se device contr Design Autor nstrate radiatio sors for ease de	tion software to ned space sensor ol of sensors a nation softwar n-hardened spa evice control o	o evolve a logic or interface moc and actuators. re to evolve a lo ace sensor inter- of sensors and ac	al sequence to dules allocating gical sequence face modules ctuators.	5			
(U) (U)	MAJOR THRUST: Develop intelligent s satellite control, precision navigation, for	atellite system t mation flying, a	echnologies fo nd proximity o	r responsive sp perations techi	pacecraft operat nologies for spa	ions and for cecraft		2.097	2.675	2.192
Proje	ct 2181			R-1 Line Iter Page-3	m No. 25 of 23 o				Exhibit R-2a (PE 0603401F)

	Exhibit R-2a, RDT&E Project Ju	stification	DA	TE February	/ 2008	
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT N 2181 Space	UMBER AND TITLE	ls	
(U)	B. Accomplishments/Planned Program (\$ in Millions) constellations.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2007: Refined command, control, guidance, and navigational capabilities for situational awareness and offensive/defensive operations. Integrated initial autono with command, control, guidance, and navigation technologies to support response hardware-in-the-loop testbed, spacecraft command and telemetry simulations, and and testing of responsive and tactical space systems. Integrated modules and com- analysis tool for engineering level, mission/engagement and campaign level analysis	or counterspace to apply to space mous flight software technologies ve space systems. Extended mission ops center to development olete distributed aperture sensor ses.				
(U)	In FY 2008: Further refine command, control, guidance, and navigational capabil Continue to integrate autonomous flight software technologies with command, con technologies. Continue to extend hardware-in-the-loop testbed, spacecraft comma mission ops centers. Begin to model command, control, and communications syst and perform military utility analysis.	ties for space superiority. trol, guidance, and navigation nd and telemetry simulations, and ems, conduct engineering trades,				
(U)	In FY 2009: Complete command, control, guidance, and navigational capabilities integration of autonomous flight software technologies with command, control, guidence, and mission ops centers. Continue to model command, control, and communication trades, and perform military utility analysis.	for space superiority. Complete idance, and navigation imand and telemetry simulations, ons systems, conduct engineering				
(U)						
(U)	MAJOR THRUST: Develop modeling, simulation, and analysis tools and data ex space-based surveillance systems, space capability protection technologies, access experiments.	ploitation methodologies for /mobility technologies, and flight	1.239	0.711	0.730	
(U)	In FY 2007: Completed development of models of surveillance systems for milita surveillance and electro-optical technologies. Further developed models of respon technologies. Applied physics-to-engineering-to-engagement level models for system mission planning and operations, and utility analysis to flight experiments in taction	ry utility to include tactical sive and reconfigurable tems engineering, tech trades, al and responsive satellites.				
(U)	In FY 2008: Begin development of space-based communications models for blue communications on the move, and data exfiltration. Complete development of more reconfigurable technologies. Continue to apply physics-to-engineering-to-engager engineering, tech trades, mission planning and operations, and utility analysis to fl responsive satellites.	force situational awareness, dels of responsive or nent level models for systems ight experiments in tactical and				
(U)	In FY 2009: Continue to develop space-based communications models for blue for	rce situational awareness,				
Proj	ect 2181 R-1 Lin	e Item No. 25 e-4 of 23		Exhibit R-2a	(PE 0603401F)	
		390				
	Exhibit R-2a, RDT&E Project Justi	fication	D/	DATE February 2008		
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BUD(03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT N 2181 Spa	UMBER AND TITLE	ls	
(U)	B. Accomplishments/Planned Program (\$ in Millions) communications on the move, and data exfiltration. Apply additional physics-to-engi models for systems engineering, tech trades, mission planning and operations, and uti experiments in tactical and responsive satellites.	neering-to-engagement level lity analysis to flight	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)						
(U) (U)	MAJOR THRUST: Develop advanced space infrared technology and hardened focal acquisition, tracking, and discrimination of hot targets, as well as "cold body" targets midcourse warheads. Note: In FY 2008, Congress reduced this effort by \$1.5 million In FY 2007: Studied detectors and readouts needed for laser-based surveillance. Invol	2.577	4.915	8.665		
(-)	fabricated on existing foundries and radiation hard design principles.	8				
(U)	In FY 2008: Continue studies for detectors and readouts needed for exquisite imaging Radiation Hardened by Design Readout Integrated Circuits (RHBD ROICs). Fold rad of visible sensor with RHBD ROIC into full focal plane array.	g. Increase size/speed of diation hardness improvement				
(U) (U)	In FY 2009: Begin full focal plane array for exquisite imaging. Develop visible sens	or for potential transition.				
(U)	MAJOR THRUST: Develop technologies for multi-access laser communications spa	ce terminals with reduced	1.302	1.054	0.733	
	weight, power, and cost for transformational communications.					
(U)	In FY 2007: Finalized brassboard integration.					
(U)	In FY 2008: Begin multi-access laser communications terminal form-fit-function dev environmental testing of multi-access laser communications terminal components and environment.	elopment. Continue I subsystems in relevant				
(U)	In FY 2009: Complete multi-access laser communications terminal form-fit-function testing of multi-access laser communications terminal components and subsystems in multi-access laser communications terminal system layer testing in relevant environments and subsystems are subsystems.	demonstration. Complete relevant environment. Initiate				
aD	multi-access faser communications terminar system rever testing in relevant environm	cht.				
(U)	MAJOR THRUST: Develop spectral/polarimetric sensing and data exploitation demo and remote sensing applications.	onstrations for military imaging	0.358	0.198	0.207	
(U)	In FY 2007: Conducted field collection with polarimetric focal plane camera. Demo	nstrated feasibility of hardware				
	design for transition to acquisition system.	-				
(U)	In FY 2008: Collect laboratory data of satellites using spectral/polarimetric sensing a techniques for space situational awareness.	nd demonstrate applicability of				
(U)	In FY 2009: Compare measurements of satellites to predictive models and determine	the feasibility of model based				
Pro	R-1 Line Ite	em No. 25		Exhibit P-22	(PE 0603401E)	
110	Fage-3	A			(i = 00004011)	

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	Exhibit R-2a, RDT&E Project Jus	lification	D.	DATE February 2008		
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITI 2181 Spacecraft Payloa		LE ads	
(U)	B. Accomplishments/Planned Program (\$ in Millions) exploitation for space situational awareness.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)						
(U) (U)	CONGRESSIONAL ADD: Precision Integrated Navigation and Position-Intelligen In FY 2007: Conducted Congressionally-directed effort for Precision Integrated Na Networking Technology.	t Networking Technology. vigation and Position-Intelligent	2.835	0.000	0.000	
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Integrated Passive Microelectronic Components.		0.978	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Integrated Passive Micro	oelectronic Components.				
(U)	In FY 2008: Not Applicable.					
(U) (U)	In FY 2009: Not Applicable.					
(U)	CONGRESSIONAL ADD: Integrated Spacecraft Engineering Tool. Note: This A in Project 633834.	dd has been previously executed	1.271	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Integrated Spacecraft E	ngineering Tool.				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Micromachined Switches for Next-Generation Modula	r Satellites.	0.978	2.393	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Micromachined Switch Satellites.	es for Next-Generation Modular				
(U)	In FY 2008: Conduct Congressionally-directed effort for Micromachined Switches	for Next-Generation Modular				
Ì	Satellites.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Systemic Hierarchical Approach to Radiation Hardened	d Electronics.	2.738	2.392	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Systemic Hierarchical A Electronics.	Approach to Radiation Hardened				
(U)	In FY 2008: Conduct Congressionally-directed effort for Systemic Hierarchical Ap Electronics.	proach to Radiation Hardened				
	R-1 Line	Item No. 25				
Pro	ect 2181 Page	-6 of 23		Exhibit R-2a	(PE 0603401F)	
	3	92				

Exhibit R-2a, RDT&E Project Justification	DAT	E February 2008	
BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603401F Advanced Spaced Technology	craft 2181 Space	MBER AND TITLE craft Payloads	
 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) In FY 2009: Not Applicable. 	<u>FY 2007</u>	<u>FY 2008</u> <u>FY 2009</u>	<u>}</u>
 (U) CONGRESSIONAL ADD: Intelligent Free Space Optical Satellite Communications Node. (U) In FY 2007: Conducted Congressionally-directed effort for Intelligent Free Space Optical Satellite Communications Node. (U) In FY 2008: Conduct Congressionally-directed effort for Intelligent Free Space Optical Satellite Communications 	1.369	1.595 0.000)
 Node. (U) In FY 2009: Not Applicable. (U) (U) CONGRESSIONAL ADD: COTS Technology for Situational Space Awareness. (U) In FY 2007: Conducted Congressionally-directed effort for COTS Technology for Situational Space Awareness. (U) In FY 2008: Conduct Congressionally-directed effort for COTS Technology for Situational Space Awareness. 	0.977	1.993 0.000)
 (U) In FY 2009: Not Applicable. (U) (U) CONGRESSIONAL ADD: Satellite Coherent Optical Receiver (SCORE). (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Satellite Coherent Optical Receiver (SCORE). (U) In FY 2009: Not Applicable. 	0.000	1.993 0.000)
(U) Total Cost	31.200	31.483 24.997	1
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u> <u>FY 2007</u> <u>FY 2008</u> <u>FY 2009</u> <u>FY 2010</u> <u>FY 2011</u> <u>Actual</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u> <u>Estimate</u>	FY 2012FY 2013EstimateEstimate	<u>Cost to</u> <u>Complete</u> <u>Total Cost</u>	t
 (U) Related Activities: (U) PE 0303601F, MILSTAR Satellite Communications System. 			
 (U) PE 0305160F, Defense Meteorological Satellite Program (DMSP). 			
(U) PE 0602601F, Spacecraft Technology.			
R-1 Line Item No. 25 Project 2181 Page-7 of 23		Exhibit R-2a (PE 0603401F	F)

	Exhibit R-2a, RDT&E I	Project Justification		DATE February 2008
BUD 03	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJEC 2181 S	CT NUMBER AND TITLE Spacecraft Payloads
(U)	C. Other Program Funding Summary (\$ in Millions)			
(U)	PE 0603311F, Ballistic Missile			
	Technology.			
(U)	PE 0603215C, Limited Defense			
	System. DE 0602219C, Desserablend			
(0)	PE 0003218C, Research and Support			
ധ	PE 0603226E. Experimental			
(-)	Evaluation of Major Innovative			
	Technologies.			
(U)	PE 0604609F, Reliability and			
	Maintainability Technology			
	Insertion Program (RAMTIP).			
(0)	This project has been coordinated through the			
	Reliance 21 process to			
	harmonize efforts and eliminate			
	duplication.			
(U)	D. Acquisition Strategy			
	Not Applicable.			
1				
1				
Pro	pject 2181	R-1 Line Item No. 25 Page-8 of 23		Exhibit R-2a (PE 0603401F)
		394		

	Ex		DATE	February	ry 2008					
BUDGET ACTIVITY 03 Advanced Technolo	ogy Development ((ATD)		P 0 T	E NUMBER AND 603401F Adv echnology	anced Space	ecraft	PROJECT NUMBER AND TITLE 3834 Integrated Space Technolog Demonstrations		
Cost (\$	in Millions)	FY 2007 Actual	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 Demonstrations	Technology	35.108	30.313	29.305	33.473	33.988	36.839	36.218	Continuing	TBD
Quantity of RDT	&E Articles	0	0	0	0	0	0	0		
 (U) <u>A. Wission Descript</u> This project is a serie Laboratory, other U.s validate the technolo (U) <u>B. Accomplishmen</u> 	s of advanced techno S. Government labora gies in an relevant en ts/Planned Program	logy demonstrat tories, and indus vironment.	ions designed try. These tec	to address miss hnologies are i	tion needs by an integrated into s	oplying emergi system-level de	ng technologie monstrations t	es from the Air hat are used to $\frac{72007}{120}$	Force Research test, evaluate, a <u>FY 2008</u>	nd <u>FY 2009</u>
 (U) MAJOK THRUST. demonstrations buil space-based space s (U) In FY 2007: Comp bus. Completed sys tests of integrated sys simulations. Perfor (U) In FY 2008: Comp environmental tests and satellite softwar (U) In FY 2009: Comp design(s) and procu 	ding on previous work ituational awareness a eted payload and bus tem level integration ystem. Integrated with ned simulated mission ete system level integrated of integrated system. e simulations. Perfor ete flight demonstration	k and leveraging and/or tactical sa of payload and n h launch vehicle on operations for gration of payloa Begin integration ion. Perform de and payload hard	investments b tellite concept formed function nicrosatellite a . Integrated gr missions oper d and microsa on with launch ssion operation orbit maneuve ware.	y other organiz s. onal and enviro and complete fu cound control sy ations training. tellite and comp vehicle. Integ as for missions er. Complete no	protection of the series	ations include of payload and avironmental lite software and atrol system aing. s of satellite		94.130	20./10	29.303
 (U) CONGRESSIONAL (U) In FY 2007: Condu Reduction. 	ADD: Radially Seg	gmented Launch -directed effort f	Vehicle (RSL) or Radially Se	V) Risk Reduct gmented Laund	tion. ch Vehicle (RS)	LV) Risk		0.978	1.595	0.000
(U) In FY 2008: Condu Reduction.	ct Congressionally-di	irected effort for	Radially Segn	nented Launch	Vehicle (RSLV	7) Risk				
(U) In FY 2009: Not A(U) Total Cost	pplicable.						3	35.108	30.313	29.305
Project 3834				R-1 Line Iten Page-9 c	n No. 25 of 23				Exhibit R-2a (I	PE 0603401F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DA	^{TE} February 2008	
BUD 03 /	GET ACTIVITY Advanced Technology Develop	oment (ATD)			PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology			PROJECT NUMBER AND TITLE 3834 Integrated Space Technology Demonstrations		
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millie</u>	ons)							
		FY 2007 Actual	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	FY 2012 Estimate	<u>FY 2013</u> Estimat	<u>Cost to</u> Complete <u>Total Cost</u>	
(U) (U) (U) (U)	Related Activities: PE 0602601F, Spacecraft Technology. PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.	<u></u>		Listinute	Loumate	Lounde	Limate	Lound	<u>comprete</u>	
(U)	D. Acquisition Strategy Not Applicable.									
Pro	ject 3834			R-1 Line Page	e Item No. 25 e-10 of 23				Exhibit R-2a (PE 0603401F)	
					396 ASSIFIED					

	Ext	hibit R-2a, F		DATE	February	2008				
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)		F C 1	PE NUMBER AND 0603401F Adv Fechnology	anced Space	ecraft	PROJECT NUME	BER AND TITLE Systems Prot	ection
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4400	Space Systems Protection	3.440	4.923	7.866	9.472	11.633	10.294	9.246	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project develops and demonstrates too environments. The project performs assess laser threats. This project also develops ter satellite protection strategies for detecting,	bls, instruments, sments of critica chnologies that avoiding, and c	and mitigation al components mitigate identi: perating in a h	n techniques re and subsystem fied vulnerabil ostile space en	equired to assure s, and evaluates ities. Technolo wironment.	e operation of U s susceptibility gies are develo	J.S. space asse and vulnerabil ped and demo	ts in potentially ity to radio freq nstrated to supp	v hostile warfigh uency (RF) and ort balanced	nting I
(U) (U) (U)	B. Accomplishments/Planned Program (\$ in Millions)FY 2007FY 2008FY 2009MAJOR THRUST: Use multi-threat assessment tools to assess space-based electro-optical, communication, and other responses to various candidate RF and laser countermeasures and directed energy threats. Note: In FY 2009, increase in funding due to increased emphasis on defensive counterspace technologies.0.8251.1821.889In FY 2007: Verified mitigation models against test data and commence predictive analysis of technique effectiveness.effectiveness.FY 2009FY 2009									
(U) (U)	In FY 2008: Conduct laboratory testing of assessment tool. In FY 2009: Conduct demonstrations illu opportunities and report findings to major	of candidate RF estrating effects commands.	and laser coun and meditation	termeasures ar analysis. Ider	nd validate mult	i-threat / transfer				
(U)	MAJOR THRUST: Develop passive sate threats to satellites. Note: In FY 2009, in technologies.	ellite countermeancrease in fundin	asures and miting due to increa	gation techniq ased emphasis	ues for current a on defensive co	and future ounterspace		1.824	2.609	4.168
(U)	In FY 2007: Conducted defensive techno transfer opportunities.	ology space dem	onstration and	post flight ana	lysis. Identified	d technology				
(U)	In FY 2008: Select the most promising demonstrations of systems integration and	etection and def	ensive technol	ogy and begin	integration. Co	onduct				
(U) (U)	In FY 2009: Conduct mitigation technolo	bgy space demo	nstration and p	ost flight analy	zsis.					
(U) (U)	MAJOR THRUST: Develop visible and a funding due to increased emphasis on def In FY 2007: Coordinated space demonstr	near-infrared las ensive counters ration of protect	ser protection t pace technolog ive technology	echnologies. 1 ies. . Identified tee	Note: In FY 200 chnology transf	09, increase in er opportunitie	5	0.791	1.132	1.809
Proje	ect 4400			R-1 Line Iter Page-11	m No. 25 of 23 7				Exhibit R-2a (I	PE 0603401F)

		Exhibit R-	Exhibit R-2a, RDT&E Project Justification										
BUD 03 /	GET ACTIVITY Advanced Technology Develor	oment (ATD)			PE NUMBER A 0603401F A Technology	ND TITLE .dvanced Space /	cecraft	PROJECT NUMBER AND TITLE 4400 Space Systems Protection					
(U) (U)	B. Accomplishments/Planned P and reported findings to major co In FY 2008: Develop selected pr protection technology. Qualify te	rogram (\$ in Mil mmands. otection technique echnology for app	l lions) es and coordinat lication on space	e space simulati e experiment for	on testing of pro	ospective tration.	J	<u>-Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>			
(U) (U)	In FY 2009: Nominate "space qu Total Cost	alified" technolog	gy and provide to	est unit to exper	imental satellite	for integration.		3.440	4.923	7.866			
(U) (U) (U) (U) (U) (U)	C. Other Program Funding Sum Related Activities: PE 0602102F, Materials. PE 0602601F, Spacecraft Technology. PE 0603605F, Advanced Weapons Technology. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	<u>mary (\$ in Milli</u> <u>FY 2007</u> <u>Actual</u>	ons) 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> <u>Complete</u>	<u>Total Cost</u>			
Pro	oject 4400			R-1 Line Page	e Item No. 25 e-12 of 23				Exhibit R-2a (PE 0603401F)			
				UNCL	398 ASSIFIED								

	Exi	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDG 03 A	ET ACTIVITY dvanced Technology Development ((ATD)		P 0 T	E NUMBER AND 603401F Adv echnology	anced Space	PROJECT NUMBER AND TITLE 5021 Space Systems Survivability			
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5021	Space Systems Survivability	4.452	4.831	5.175	5.229	5.431	5.380	5.342	Continuing	TBD
<u> </u>	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U)	A. Mission Description and Budget Item This project develops and demonstrates tec that must continue operation despite natura interactions including electrical charge bui	Lustification chnologies to im al space hazards ldup and electro	prove space sy It develops an nics failures du	stem survivabi nd demonstrate ue to both singl	lity and reliabil es cost-effective le radiation eve	lity of current a e solutions to m nts and long-te	nd future Dep itigate hazard rm radiation d	artment of Defe ous space enviro oses.	ense space syste onmental	ms
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop sensors to so operation of satellite, communication, naviand operation of instrumentation to provide forecasting.	(\$ in Millions) pecify and forec vigation, and sur de improved spa	ast conditions veillance syste ce radiation an	in the space en ms. Support in d ionospheric l	vironment that ntegration, laun hazard specifica	degrade the tch, validation, ation and	<u>F</u> Y	<u>7 2007</u> 3.444	<u>FY 2008</u> 3.657	<u>FY 2009</u> 3.953
(U) (U)	In FY 2007: Identified space test opportu imager for solar hazard detection. Compl and developed initial engineering models. In FY 2008: Continue construction of joi Continue development of miniaturized sp evaluate empirical flare prediction models	Inity and constru- leted concept de Int agency coron- ace weather sen s based on syno	Incted prelimina sign of next-ge agraph and hel sor engineering ptic data from a	ry joint agency neration minia iospheric imag g models. Initi Air Force and r	v coronagraph a turized space w ger for solar haz ate program to national observa	and heliospheric reather sensors and detection. test and atory assets.	2			
(U)	In FY 2009: Continue construction of joi Complete development of miniaturized sp miniaturized solar hazard sensors. Contin synoptic data from Air Force and national	int agency coron pace weather ser nue program to t l observatory as	agraph and hel sor engineerin est and evaluat sets.	iospheric imag g models. Ider e empirical fla	ger for solar haz ntify space test re prediction m	card detection. opportunity for odels based on				
(U) (U)	MAJOR THRUST: Conduct collaborativ	ve space and lab	oratory experin	nents and deve	lop hardware a	nd software		0.328	0.379	0.398
(U)	In FY 2007: Constructed space plasma conspaceflight. Expanded spacecraft environ forecast models. Completed radiation bell Force test satellite.	ecraft power, co ontrol experime ment effect too It remediation pa	mmunications, nt payload and suite to includ ayload and con	navigation, an established joi le dynamic spa nmenced calibr	a surveillance s nt-agency colla ce particle clim ation and integ	systems. boration for hatologies and ration onto Air				
(U)	In FY 2008: Complete space plasma com Force test satellite. Complete spacecraft of	trol experiment environment eff	payload and be ect tool suite to	gin calibration include dynar	and integration	n onto Air cle				
Proj	ect 5021			R-1 Line Iten Page-13	n No. 25 of 23				Exhibit R-2a (I	PE 0603401F)

DATE February 2008											
PROJECT NUMBER AND TITLE 5021 Space Systems Survivability											
<u>.008 FY 2009</u>											
.795 0.824											
In FY 2007: Employed full energy spectra algorithms to convert entire compact environment anomaly sensor data bases into dynamic climatological model for anomaly resolution and space system design. Constructed initial hardware for space demonstration of the distributed anomaly resolution sensor. Calibrated and integrated compact environment anomaly sensor for diagnosing severe radiation environment on Air Force test satellite.											
.831 5.175											
<u>Cost to</u> <u>Total Cost</u>											
<u>mpiete</u>											
ibit R-2a (PE 0603401F)											
4. <u>C</u>											

	Exhibit R-2a, RDT&	E Project Justification	DATE February 2008
BUDO 03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 5021 Space Systems Survivability
(U)	<u>C. Other Program Funding Summary (\$ in Millions)</u> duplication.		
(U)	D. Acquisition Strategy Not Applicable.		
Proj	ect 5021	R-1 Line Item No. 25 Page-15 of 23	Exhibit R-2a (PE 0603401F)

	Exi	hibit R-2a, F	RDT&E Pro	ject Justif	fication			DATE	February	2008
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)		-	PE NUMBER AND 0603401F Adv Technology	anced Space	PROJECT NUMI 5083 Ballisti	ECT NUMBER AND TITLE Ballistic Missiles Technology		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
5083	Ballistic Missiles Technology	2.990	5.806	5.649	5.179	5.429	6.259	6.077	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U)	This project develops, integrates, and demo	onstrates advance al navigation ins on missile syste	ed technologie truments to su ms.	es for sustainm stain current b	nent and modern allistic missile s	ization of strate systems, as well	egic ballistic m l as provide ne	nissiles. The pr w, small, low-p	oject focuses or oowered, high	
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop, integrate, a vehicle designs and other technologies that technology concepts to support future spa	(\$ in Millions) and demonstrate at sustain curren ace force applica	advanced navi t strategic miss tion and strate	gation instrum sile systems. 1 gic systems.	nentation applied Provide critical n	l to emerging missile	<u>FY</u>	<u>7 2007</u> 1.495	<u>FY 2008</u> 2.903	<u>FY 2009</u> 2.825
(U) (U)	In FY 2007: Developed and integrated en tested in environments relevant to subseq improvements to meet established perform In FY 2008: Continue next generation m	ngineering desig uent flight test c nance goals. Pl issile navigation	n next generation onditions. Eva anned flight tea system engine	ion missile nav aluated system st demonstrativ eering develop	vigation systems a performance ar on. oment, design, ar	s and ground nd provided nd ground test				
(U)	in relevant strategic environments, and ev Continue flight test demonstration plannin In FY 2009: Continue engineering syster improvements. Conduct flight qualificati system integration of flight demonstration	valuate design in ng. Initiate engin n development of on testing and e n units with eme	nprovements as neering system lesign verificat valuation of ca rging vehicle c	gainst establish n design verifi- tion and testin andidate demon designs.	hed performance cation and testin g to incorporate nstration flight u	e goals. Ig. performance Inits. Initiate				
(U) (U)	MAJOR THRUST: Develop, integrate, a to provide robust, flexible, lower cost solu	nd demonstrate	advanced navi	gation technol	logies with new	vehicle designs	3	1.495	2.903	2.824
(U)	In FY 2007: Performed additional long-tr coordination with test facilities in prepara instrumentation and range safety devices. devices with associated platform hardwar times the gravitational force flight-like vi test bed.	erm planning an ition for sled tes Measured perf e, power source bration environi	d developed in ting of high-gr ormance of nav s, support softv nents. Interfac	avitational for vigation instru ware, and com ced system lev	l hardware acqui ce tolerant navig mentation and r munication inte el design with e	isition and gation ange safety rfaces in 100 xperimental				
(U)	In FY 2008: Complete test planning, intenavigational instrumentation and range sa	gration, and con	iduct sled testin preparation for	ng of high-gra future flight t	vitational force est demonstratio	tolerant ons. Continue				
Proj	ect 5083			R-1 Line Ite Page-16	m No. 25 3 of 23				Exhibit R-2a (I	PE 0603401F)
				402	2					

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUD 03 A	GET ACTIVITY Advanced Technology Developr	ment (ATD)			PE NUMBER A 0603401F A Technology	ND TITLE dvanced Space	cecraft	PROJECT NUMBER AND TITLE 5083 Ballistic Missiles Technology			
(U)	B. Accomplishments/Planned Pr performance evaluation of navigati software interfaces in relevant dyn long-term plan for flight testing ad designs.	ogram (\$ in Mil ion instrumentati amic and hostile vanced navigation	lions) on and range sa environments. onal instrumenta	fety devices wit Validate system tion and range s	h associated hard design refineme afety devices wi	dware and ents and initiate th new vehicle safety devices	E	E <u>Y 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(0)	from experimental test bed and slee for flight testing advanced navigati Initiate qualification testing of desi	d testing. Continued of a continued	nue long-term pl ntion and range s lated system lev	anning and initi safety devices w el interfaces.	ate long-lead har	design interface	on s.				
(U)	Total Cost	0 0	5					2.990	5.806	5.649	
(U)	C. Other Program Funding Sumr	nary (\$ in Millio <u>FY 2007</u> Actual	<u>5005)</u> <u>FY 2008</u> Estimato	<u>FY 2009</u> Estimata	<u>FY 2010</u> Estimato	FY 2011 Estimato	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u>	<u>Total Cost</u>	
(U) (U) (U) (U) (U) (U) (U)	PE 0601102F, Defense Research Sciences. PE 0602601F, Space Technology. PE 0603311F, Ballistic Missile Technology. PE 0603601F, Conventional Weapons Technology. PE 0603851F, Intercontinental Ballistic Missile-Dem/Val. PE 0604851F, Intercontinental Ballistic Missile-EMD. PE 0605860F, Rocket System Launch Program-Space. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate										
Pro	ject 5083			R-1 Line Page	e Item No. 25 e-17 of 23 403				Exhibit R-2a	(PE 0603401F)	

Exhibit R-2a, RDT&	DATE Februarv 2008	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NUMBER AND TITLE 5083 Ballistic Missiles Technology
(U) <u>D. Acquisition Strategy</u>		
Not Applicable.		
	R-1 Line Item No. 25	
Project 5083	Page-18 of 23	Exhibit R-2a (PE 0603401F)

	Ext	nibit R-2a, F	RDT&E Pro	oject Justifi	cation				DATE	February	2008
BUDGET ACTIVIT 03 Advanced 1	echnology Development (ATD)		P 0 T	E NUMBER AND 603401F Adv echnology	anced Space	ecraft	PROJEC 682J S	T NUMBE	ER AND TITLE aft Vehicles	
	Exhibit R-2a, RDT&E Project Justification Date February 2008 JBET ACTIVITY Advanced Technology Development (ATD) FE NUMBER AND TITLE 0003401F Advanced Spacecraft Technology PROJECT NUMBER AND TITLE 0622 Spacecraft Vehicles Cost (\$ in Millions) FY 2007 Actual Estimate FY 2008 Estimate FY 2010 Estimate FY 2011 Estimate FY 2013 Estimate Cost to Estimate Total Estimate 21 Spacecraft Vehicles 28.322 23.244 7.966 8.080 8.779 11.481 11.402 Continuing TBD Quantity of RDT&EE Articles 0										
	Cost (\$ in Minions)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estir	nate	Complete	
682J Spacec	aft Vehicles	28.232	23.244	7.966	8.080	8.779	11.481	-	11.402	Continuing	TBD
Quantit	y of RDT&E Articles	0	0	0	0	0	0		0		
Advanced Devel 0603211F, Aeros (U) <u>A. Mission</u> This projec technologie Energy stor satellite mis	ppment, Project 634216, for exe pace Technology Development Description and Budget Item develops and demonstrates con s, including cryogenic cooling to age work focuses on lightweigh sions. The project's power dist	ecution. Also, f t and Demonstra <u>Justification</u> mpact, low-cost technologies. P nt nickel hydrog ribution efforts	unds for the F ation, Project 6 , spacecraft an ower generation en and sodium focus on produ	Y 2007 Congres 3486U, to this d launch vehicl on activities foc sulfur spacecra	ssionally-direct PE, for execution e power generatus us on lightweig aft batteries and ht. high-efficie	ted Advanced S on. ation, storage, c ght, low-cost, lo d flywheel ener ncy, standardiz	atellite Thern listribution, ar ow-volume, ar gy storage sys ed power buss	nal Contr nd therma nd surviv stems for uses for us	al manag able sola extended se on fut	am were move gement ar cell arrays. d (five to ten y ure space syste	ed from PE year) ems.
 (U) <u>B. Accom</u> (U) MAJOR T multi-junc solar cell r (U) In FY 200 solar array (U) In FY 200 Complete for advanc (U) In FY 200 	plishments/Planned Program HRUST: Develop and evaluate tion solar cells, advanced thin f nodules. 7: Performed radiation testing of Demonstrated roll-to-roll pro B: Complete fabrication of fligh ground portion of on-orbit pred ed multijunction solar cell struct D: Demonstrate greater than 14 n 40% efficient solar cell conce	(\$ in Millions) e performance of ilm solar cells, i of five to six ju duction of thin- ht hardware for iction model for ctures. % efficient thin	f space conver ightweight fle nction solar ce film solar cells Thin-Film Rac thin-film solar -film solar cell	ntional power g xible solar cell ells. Constructe s on polymer su diation Exposur r cells. Develo ls. Begin perfo	eneration techn arrays, and rad d flight hardwa bstrates. e flight experir p interconnect ormance optimi	ologies such as iation resistant ure for thin-film nent. technologies zation of	<u>F</u> Y	<u>7 2007</u> 1.566		<u>FY 2008</u> 2.330	<u>FY 2009</u> 1.660
(U)	ii 40% efficient solar cen conce	.prs.									
(U) MAJOR T and integra	HRUST: Develop technologies	s for long life, e lications.	fficient, low-v	ibration, lightw	eight mechanic	cal cryocoolers		1.005		1.316	1.169
 (U) In FY 200 concepts to application cooling red (U) In FY 200 membrane 	7: Assessed various advanced o further reduce cryocooler mas as. Developed initial advanced quirements for space-based space 3: Complete design and begin of technology. Complete design	technologies su s and improve p concept program ce surveillance a development of and begin devel	ch as micro-ele performance for n to support m and other missi a non moving opment of a lo	ectro-mechanic or space based s nulti-temperatur ion applications parts compress ow vibration cor	al, optical cool ituational awar e and large foc s. or using proton nductance, cros	ing, and other eness al plane biased s gimbal 35 K					
Project 682J				R-1 Line Item Page-19	n No. 25 of 23					Exhibit R-2a (PE 0603401F)

	Exhibit R-2a, RDT&E Project Just	ification	DA	TE February	2008
BUDO 03 A	BET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NI 682J Spac	UMBER AND TITLE	5
(U)	B. Accomplishments/Planned Program (\$ in Millions) cooling loop interface to support space tracking missions. Complete design and begi thermal interface material doubling conductive transfer capacity in space cooling app comprehensive study and begin technology development of satellite cryogenic interfa- technologies to support space tracking applications.	n development of an improved plications. Complete ace requirements and improved	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Continue development of a non moving parts compressor using proton Continue development of a low vibration conductance, cross gimbal 35 K cooling loo tracking missions. Continue development of an improved thermal interface material capacity in space cooling applications. Continue technology development of satellite requirements and improved technologies to support space tracking applications	biased membrane technology. op interface to support space doubling conductive transfer e cryogenic interface			
(U) (U)	MAJOR THRUST: Develop composites for launch vehicle and spacecraft structures launch vehicle shrouds, thermal protection structures, and space antennas. Note: In due to acceleration of the thermal management testbed program.	and space applications, such as FY 2008, increase in funding is	2.958	5.172	2.884
(U)	In FY 2007: Demonstrated space qualification-level performance for large diameter Transitioned multi-functional structures technology to unmanned aerial vehicle and l Demonstrated space qualification-level performance for 25-meters long ultralightwei	launch vehicle fairing. aunch vehicle community. ght deployable structures.			
(U)	In FY 2008: Develop symbiotic structural technologies for large deployable structure management sensors. Perform flight-qualification tests of novel deployable structure and launch vehicle structural components. Develop thermal management testbed.	al sensors and improved thermal e architectures, cryogenic tanks,			
(U)	In FY 2009: Fly elastically-deployed, stored strain energy, deployable structural arch memory alloy reinforced hinges. Develop and test thermal management hardware.	hitectures including shape			
(U) (U)	MAJOR THRUST: Develop technologies for spacecraft structural controls and mech applications such as advanced high power solar array subsystems, sensitive payload is payload isolation systems.	hanisms for on-orbit solation systems, and miniature	2.074	2.363	2.253
(U)	In FY 2007: Ground demonstrated full multi-axis flywheel attitude control system w Demonstrated space qualification-level performance for passive vibro-acoustic damp vehicle acoustic loads. Flight demonstrated on-orbit docking and fluid transfer mech	ith integrated energy storage. ing devices to mitigate launch anisms.			
(U)	In FY 2008: Implement estimation algorithm for improved local situational awarene asset.	ss using on existing on-orbit			
(U)	In FY 2009: Begin implementation of advanced estimation algorithms for improved	local situational awareness onto			
Proj	ect 682J R-1 Line It Page-2 ۸۲	em No. 25 0 of 23 06		Exhibit R-2a	(PE 0603401F)

	Exhibit R-2a, RDT&E Project Jus	stification	DA	TE February	2008
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT NI 682J Spac	UMBER AND TITLE	5
(U)	B. Accomplishments/Planned Program (\$ in Millions) flight hardware prototype under development.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)					
(U)	CONGRESSIONAL ADD: Information Sciences Institute Microsatellite Serial Ma Program.	anufacturing Demonstration	0.977	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Information Sciences I Manufacturing Demonstration Program.	Institute Microsatellite Serial			
(U)	In FY 2008: Not Applicable.				
(U) (U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Photovoltaic Module Development for Lighter than A	ir Vehicles.	0.978	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Photovoltaic Module I Vehicles.	Development for Lighter than Air	0.570	0.000	0.000
(U)	In FY 2008: Not Applicable.				
(U) (U)	In FY 2009: Not Applicable.				
(U)	CONGRESSIONAL ADD: Space Situational Awareness/Star Tracking System.		1.564	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Space Situational Awa	reness/Star Tracking System.			
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Advanced Satellite Thermal Control Program.		1.369	0.000	0.000
(U)	In FY 2007: Conducted Congressionally-directed effort for Advanced Satellite The	ermal Control Program.			
(U) (U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)	CONCRESSIONAL ADD: This Film Amorphous Solar Arrays		10 168	3 100	0.000
(0)	In FY 2007: Conducted Congressionally-directed effort for Thin Film Amorphous	Solar Arrays	10.108	5.190	0.000
(U)	In FY 2008: Not Applicable	bolai Allays.			
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Large Automated Production of Expendable Launch S	tructure (LAPELS).	2.542	4.287	0.000
	R-1 Line	e Item No. 25			
Proje	ect 682J Page	-21 of 23		Exhibit R-2a	(PE 0603401F)

BUDGET ACTIVITY PE NUMBER AND TILE (663240F Advanced Spacecraft PROJECT NUMBER AND TILE (663240F Advanced Spacecraft PROJECT NUMBER AND TILE (663240F Advanced Spacecraft Vehicles (U) B. Accomplishments/Planned Program (S in Millions) FY 2007 FY 2008 FY 2008 FY 2009 (U) In FY 2007. Conducted Congressionally-directed effort for LAPELS. FY 2007 FY 2008 FY 2009 FY 2009 (U) In FY 2007. Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing. 1.955 1.955 0.000 (U) In FY 2008. Not Applicable. 1.955 1.955 0.000 (U) In FY 2008. Not Applicable. 1.076 1.975 0.000 (U) In FY 2007. Conducted Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft. 1.076 1.975 0.000 (U) In FY 2007. Not Applicable. 0.000 1.196 0.000 (U) In FY 2007. Not Applicable. 0.000 1.196 0.000 (U) In FY 2008. Not Applicable. 0.000 1.196 0.000 (U) In FY 2008. Not Applicable. 0.000 1.96 0.000 (U) In FY 2008. Not Applicable. <t< th=""><th></th><th></th><th>Exhibit R-</th><th>2a, RDT&E</th><th>Project Jus</th><th>stification</th><th></th><th></th><th>DATE</th><th>February</th><th>2008</th></t<>			Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
UD B. Accomplishments/Planned Program (\$ in Millions) FY 2007 FY 2007 FY 2008 FY 2009 FY 2009 FY 2009 FY 2009 Not Applicable. UD In FY 2008 Not Applicable. 1955 1.595 0.000 UD In FY 2008 Not Applicable. 1955 1.595 0.000 UD In FY 2008 Not Applicable. 1955 1.595 0.000 UD In FY 2008 Not Applicable. 1955 1.595 0.000 UD In FY 2008 Not Applicable. 1955 1.795 0.000 UD In FY 2008 Not Applicable. 1005 1.795 0.000 UD In FY 2008 Not Applicable. 1005 1.795 0.000 UD In FY 2008 Not Applicable. 1005 1.196 0.000 UD In FY 2008 Not Applicable. 1196 0.000 UD In FY 2008 Not Applicable. 28.232 23.244 7.966 UD In FY 2008 Not Applicable. 28.232 23.244 7.966 UD	BUD(03 A	GET ACTIVITY dvanced Technology Develop	ment (ATD)			PE NUMBER A 0603401F A Technology	ND TITLE Idvanced Space /	ecraft	PROJECT NUM 682J Space	IBER AND TITLE	5
 (U) CNGRESSIONAL ADD: Microsatellite Serial Manufacturing. I.955 I.595 0.000 In FY 2007: Conducted Congressionally-directed effort for Microsatellite Serial Manufacturing. (U) In FY 2008: Not Applicable. (U) In FY 2007: Conducted Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft. (U) In FY 2007: Conducted Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft. (U) In FY 2007: Conducted Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft. (U) In FY 2007: Not Applicable. (U) In FY 2007: Not Applicable. (U) In FY 2008: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Space Situational Awareness. (U) In FY 2009: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Space Situational Awareness. (U) In FY 2009: Not Applicable. (U) Total Cost 28.232 23.244 7.966 (U) C.Other Program Funding Summary (S in Millions) <u>FY 2007</u> <u>FY 2008</u> <u>FY 2009</u> <u>FY 2010</u> <u>FY 2012</u> <u>FY 2013</u> <u>Cost to</u> <u>Total Cost</u> (U) Related Activities: (U) PE 0602203F, Aerospace <u>Propulsion.</u> (U) PE 0603218C, Research and Support. (U) PE 0603228E, Experimental Evaluation of Major Innovative <u>R-1 Line Item No. 25</u> <u>Project 6823</u> <u>Exhibit R-2a (PE 0603401F)</u> 	(U) (U) (U) (U)	B. Accomplishments/Planned Pr In FY 2007: Conducted Congress In FY 2008: Not Applicable. In FY 2009: Not Applicable.	ogram (\$ in Mil ionally-directed e	lions) effort for LAPE	LS.				FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) CONGRESSIONAL ADD: Small Low-Cost Reconnaissance Spacecraft. 1.076 1.795 0.000 (U) In FY 2007: Conducted Congressionally-directed effort for Small Low-Cost Reconnaissance Spacecraft. 1 1.1795 0.000 (U) In FY 2008: Not Applicable.	(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Micro In FY 2007: Conducted Congress In FY 2008: Not Applicable. In FY 2009: Not Applicable.	osatellite Serial M ionally-directed e	Ianufacturing. effort for Micro	satellite Serial M	lanufacturing.			1.955	1.595	0.000
 (U) (U) CONGRESSIONAL ADD: Space Situational Awareness. (U) In FY 2007: Not Applicable. (U) In FY 2008: Conduct Congressionally-directed effort for Space Situational Awareness. (U) In FY 2009: Not Applicable. (U) Total Cost 28.232 23.244 7.966 (U) C. Other Program Funding Summary (\$ in Millions) FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Actual Estimate Estimate Estimate Estimate Estimate Complete Total Cost (U) Related Activities: (U) PE 0602203F, Aerospace Propulsion. (U) PE 0602201F, Spacecraft Technology. (U) PE 0603218C, Research and Support. (U) PE 0603226E, Experimental Evaluation of Major Innovative R-1 Line Item No. 25 Page-22 of 23 Exhibit R-2a (PE 0603401F). 	(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Small In FY 2007: Conducted Congress In FY 2008: Not Applicable. In FY 2009: Not Applicable.	Low-Cost Reconionally-directed e	nnaissance Space Effort for Small	cecraft. Low-Cost Reco	nnaissance Spac	ecraft.		1.076	1.795	0.000
U) Total Cost 28.232 23.244 7.966 (U) C. Other Program Funding Summary (\$ in Millions) EY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Total Cost (U) Related Activities: (U) PE 0602203F, Aerospace Propulsion. Complete Total Cost (U) PE 06022103F, Aerospace Propulsion. PE 0603218C, Research and Support. Support. PE 0603226E, Experimental Evaluation of Major Innovative (U) PE 0603226E, Experimental Evaluation of Major Innovative R-1 Line Item No. 25 Page-22 of 23 Exhibit R-2a (PE 0603401F)	(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Space In FY 2007: Not Applicable. In FY 2008: Conduct Congression In FY 2009: Not Applicable.	Situational Awa	ireness. ort for Space Si	tuational Aware	ness.			0.000	1.196	0.000
(U) C. Other Program Funding Summary (\$ in Millions) FY 2007 FY 2008 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Total Cost Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Cost (U) Related Activities: (U) PE 0602203F, Aerospace Propulsion. FY 2007 FY 2010 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Complete Total Cost (U) PE 0602203F, Aerospace Propulsion. FY 2003218C, Research and FY 2012 FY 2012 FY 2013 Cost to Complete FY 2012 FY 2013 Cost to FY 2014 Cost FY 2012 FY 2013 Cost to FY 2012 FY 2013 Cost to FY 2012 FY 2013 Cost FY 2013 Cost FY 2013 Cost FY 2013 F	(U)	Total Cost							28.232	23.244	7.966
FY 2007 FY 2008 FY 2009 FY 2010 FY 2011 FY 2012 FY 2013 Cost to Total Cost Actual Estimate Estimate Estimate Estimate Estimate Estimate Complete Total Cost (U) Related Activities: (U) PE 0602203F, Aerospace Propulsion. Propulsion. V PE 0602601F, Spacecraft Technology. V PE 0603218C, Research and Support. V PE 0603226E, Experimental Evaluation of Major Innovative R-1 Line Item No. 25 Project 682J Page-22 of 23 Exhibit R-2a (PE 0603401F)	(U)	C. Other Program Funding Sum	<u>mary (\$ in Millio</u>	ons)						~	
Project 682J Page-22 of 23 Exhibit R-2a (PE 0603401F)	(U) (U) (U) (U) (U)	Related Activities: PE 0602203F, Aerospace Propulsion. PE 0602601F, Spacecraft Technology. PE 0603218C, Research and Support. PE 0603226E, Experimental Evaluation of Major Innovative	<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> <u>Estimate</u> R-1 Line	Estimate Estimate	<u>Estimate</u>	<u>FY 2012</u> Estimate	<u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
	Pro	ect 682J			Page	e-22 of 23				Exhibit R-2a	(PE 0603401F)

Exhibit R-2a, RDT&E	Exhibit R-2a, RDT&E Project Justification									
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	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>										
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) D. Acquisition Strategy Not Applicable.										
Project 682J	R-1 Line Item No. 25 Page-23 of 23	Exhibit R-2a (PE 0603401F)								

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

	Exhib	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDG 03 A 0	ET ACTIVITY dvanced Technology Development (/	ATD)		PI 0	E NUMBER AND 603444F MA	UI SPACE SU	RVEILLANC	E SYSTEM		
	Cost (\$ in Millions)	FY 2007	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to	Total
	Total Program Element (PE) Cost	49 502	42.160	4 838	5 902	6 029	5 704	5 683	Continuing	TBD
4868	Maui Space Surveillance System	49.502	42.160	4.838	5.902	6.029	5.704	5.683	Continuing	TBD
(U) <u>4</u> 1 1	A. Mission Description and Budget Item This program funds space situational aware operation and upgrade of the facility. Note for MSSS Operations and Research, and \$9 Activity 3, Advanced Technology Develop have military utility and address warfighter	Justification eness technology : In FY 2008, C 0.0 million for the ment, since it en- needs.	y development congress added ne Panoramic S nables and den	and demonstra \$5.2 million fo Survey Telescop nonstrates techr	ation at the Man or the High Acc pe and Rapid R nologies for exi	ui Space Survei curacy Network Response Syster isting system up	llance System Determinatior n (PanSTARR: ogrades and/or	(MSSS) in Haw 1 System (HAN S). This progra new system dev	vaii, as well as IDS), \$23.0 mil m is in Budget velopments tha	the Ilion t
(U)	B. Program Change Summary (\$ in Mil	<u>lions)</u>					EV 2007	EV 2	000	EV 2000
(U) (U) (U) (U)	Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer Significant Program Changes: Not Applicable. C. Performance Metrics Under Development.						<u>FY 2007</u> 50.383 49.502 -0.881 0.053 -0.934	<u>FY 2</u> 5 42 36 -0. 37	2008 .237 .160 .923 .277 .200	<u>FY 2009</u> 5.338 4.838
				R-1 Line Item Page-1 411	n No. 26 of 4				Exhibit R-2 (I	PE 0603444F)
				UNCLASS	SIFIED					

	Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDGE 03 Ac	ET ACTIVITY Ivanced Technology Development ((ATD)		PI 0 S	E NUMBER AND 603444F MAU URVEILLAN	UI SPACE		PROJECT NUMI 4868 Maui Sj	BER AND TITLE	ance System
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
4868	Maui Space Surveillance System	49.502	42.160	4.838	5.902	6.029	5.704	5.683	Continuing	TBD
	Quantity of RD1&E Articles	0	0	0	0	0	0	0		
c f A h	peration and upgrade of the facility. Not or MSSS Operations and Research, and \$ Activity 3, Advanced Technology Develop ave military utility and address warfighte B Accomplishments/Planned Program	e: In FY 2008, C 69.0 million for the pment, since it energy er needs.	congress added ne Panoramic S nables and dem	\$5.2 million fo Survey Telescop nonstrates techr	or the High Acc pe and Rapid R nologies for exi	curacy Network Response System asting system up	Determination n (PanSTARR ogrades and/or	n System (HAN S). This progra new system de	NDS), \$23.0 mi am is in Budget velopments tha	t
(U) (U)	MAJOR THRUST/CONGRESSIONAL technology at the Maui Space Surveilland Note: This effort includes Congressional In FY 2007: Continued MSSS infrastruc customers and experimenters. Upgraded and security. Continued development an operational support for space situational Assessed military utility, enhanced missi development of advanced adaptive optics of dim objects. Provided health/status, ic ultra-precise astrodynamics techniques an	ADD: Develop, ce System (MSS Adds of \$25.0 n cture contribution and modernized d implementatio awareness (SSA) on effectiveness, s system for impr dentification, and nd electro-optic	demonstrate, a S) in Hawaii, a hillion in FY 20 as for research, facilities, teles n of self-suffic b, space system and transition roved imaging anomaly resolu- characterization	and integrate sp as well as opera 007 and \$23.0 r development, a scopes, and sen iency plan. De characterization ed technology f performance, re lution for select n.	bace situational ate and upgrade million in FY 2 and operations asors. Maintain eveloped concepton, and active the to user comman eliability, and context ted satellites us	awareness the facility. 008. that supported red site safety pts to provide racking. nds. Initiated characterization	3	30.436	28.052	4.838
(U) (U)	Control Display Severage in the second of the second second of the second of the second second of the second of the									
Proje	ct 4868			R-1 Line Item Page-2 0 412	n No. 26 of 4				Exhibit R-2a (PE 0603444F)

		Exhibit R-	-2a, RDT&E	Project Jus	tification			DATE	February	2008
BUDG 03 A	BET ACTIVITY dvanced Technology Developi	ment (ATD)			PE NUMBER A 0603444F M SURVEILLA	ND TITLE		PROJECT NUM 4868 Maui S	BER AND TITLE	ance System
(U)	B. Accomplishments/Planned Pr	ogram (\$ in Mil	<u>llions)</u>				<u>F</u>	<u>Y 2007</u>	<u>FY 2008</u>	FY 2009
(U) (U) (U)	CONGRESSIONAL ADD: Panor In FY 2007: Completed Maui sing demonstration completed. Began in planning to support installation of	amic Survey Tel gle telescope Par military utility de Pan-STARRS fo	lescope And Rap n-STARRS inclu emonstration. P pur-telescope sys	pid Response Sy iding system inte rovided informa stem.	stem (Pan-STAI egration and test tion on Mauna I	RRS). ing. Initial Kea site strategic		11.244	8.941	0.000
(U) (U)	In FY 2008: Maui telescope will t four-telescope system design and c In FY 2009: Not Applicable.	ransition into rou development bas	utine use for sky ed on lessons lea	y surveys. Comp arned from Mau	lete utility demo i installation/ope	onstration. Initia erations.	te			
(U) (U) (U)	CONGRESSIONAL ADD: High In FY 2007: Developed small auto of space situational awareness. Su operating rights request to deploy to	Accuracy Netwo phomous operati apported precisio telescope to Aus	ork Determination ng telescopes lin n satellite metrico tralia.	on System (HAN hked into a netwo cs, photometry, a	DS). ork to provide a and hand-off. In	testbed in supportities the support	rt	7.822	5.167	0.000
(U)	In FY 2008: Support research acti capabilities. Complete foreign ope improved small autonomous telesc In FX 2008: Not Applicable	vities and data c erating rights pro cope with increas	ollection to improcess and deploy sed data collection	rove persistent s a small telescop on capabilities.	pace situational be to Australia.	awareness Develop				
(U)	Total Cost							49.502	42.160	4.838
(U)	C. Other Program Funding Sumr	<u>mary (\$ in Milli</u>	<u>ons)</u>							
		<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> <u>Estimate</u>	FY 2012 Estimate	<u>FY 2013</u> Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
(U) (U)	Related Activities: PE 0602605F, Directed Energy Technology.									
(U)	PE 0603605F, Advanced Weapons Technology.									
(U)	PE 0601108F, High Energy Laser Research Initiatives.									
(U)	PE 0602890F, High Energy Laser Research.									
(U)	PE 0603924F, High Energy									
Proj	ect 4868			R-1 Line Pag	Item No. 26 Je-3 of 4				Exhibit R-2a	(PE 0603444F)

Exhibit R-2a, RDT&E	DATE February 2008	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603444F MAUI SPACE SURVEILLANCE SYSTEM	PROJECT NUMBER AND TITLE 4868 Maui Space Surveillance System
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Laser Advanced Technology Program. (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. 		
Project 4868	R-1 Line item No. 26 Page-4 of 4 414	Exhibit R-2a (PE 0603444F)

PE NUMBER: 0603601F PE TITLE: Conventional Weapons Technology

	Exhib	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUD(03 A	GET ACTIVITY Advanced Technology Development (/	ATD)		PI 0	E NUMBER AND 603601F Con	TITLE	eapons Tech	nology		
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
	Total Program Element (PE) Cost	38.602	18.379	11.813	17.942	18.167	21.910	18.902	Continuing	TBD
670.	A Conventional Weapons Development	38.602	18.379	11.813	17.942	18.167	21.910	18.902	Continuing	TBD
(U)	A. Mission Description and Budget Item This program develops, demonstrates, and development of conventional ordnance tech navigation and control, and guidance. Note Technology Development, since it develop address warfighter needs.	Justification integrates ordna nnologies incluc e: In FY 2008, s and demonstra	nce and advan ling warheads, Congress adde ates technologi	ced guidance to fuzes, and exp d \$1.6 million es for existing	echnologies for losives; and de for Moving Tar system upgrade	r air-launched c velopment of a rget Strike. Th es and/or new s	onventional we dvanced guidar is program is in ystem developi	eapons. The pro- nce technologie the Budget Ac ments that have	ogram includes s including see tivity 3, Advar military utility	s kers, nced y and
(U)	B. Program Change Summary (\$ in Mil	<u>lions</u>)					EV. 2007			EX 2000
	Duraniana Durasi dant'a Durdant						<u>FY 2007</u>	$\frac{FY}{2}$	2008	<u>FY 2009</u> 12 704
(\mathbf{U})	Current DPD/Dresident's Budget						38.330	10	.904	13.794
(0)	Total Adjustments						38.002	10	.379 .75	11.015
(0)	Congressional Program Reductions						0.072	-0	004	
(0)	Congressional Rescissions							-0	.121	
	Congressional Increases							1	.600	
	Reprogrammings						0.949			
	SBIR/STTR Transfer						-0.877			
(U)	<u>Significant Program Changes:</u> Not Applicable.									
	C. Performance Metrics									
	(U) Under Development.									
				R-1 Line Iten Page-1	n No. 27 of 6				Exhibit R-2 (PE 0603601F)
				415 UNCLASS	SIFIED					

Exhibit R-2a, RDT&E Project Justification									February	2008
BUDO 03 A	GET ACTIVITY dvanced Technology Development (A	ATD)		F C 1	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology			PROJECT NUMBER AND TITLE 670A Conventional Weapons Development		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
6704	A Conventional Weapons Development	38.602	18.379	11.813	17.942	18.167	21.910	18.902	Continuing	TBD
	Quantity of RD1 &E Articles		0	0	0	0	0	0		
	This program develops, demonstrates, and development of conventional ordnance tech navigation and control, and guidance. Note Technology Development, since it develop address warfighter needs.	integrates ordna nnologies includ e: In FY 2008, s and demonstra	nce and advan ling warheads, Congress adde ates technologi	ced guidance t fuzes, and exp d \$1.6 million es for existing	technologies for olosives; and de for Moving Tar system upgrade	air-launched c velopment of a get Strike. Th es and/or new s	onventional w dvanced guida is program is i ystem develop	eapons. The pr nce technologie n the Budget Ac ments that have	ogram includes es including see ctivity 3, Advar e military utility	kers, nced and
 (U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u> (U) MAJOR THRUST: Develop and demonstrate advanced air-delivered munitions fuze and mass-focusing warhead (U) MAJOR THRUST: Develop and demonstrate advanced air-delivered munitions fuze and mass-focusing warhead (U) MAJOR THRUST: Develop and demonstrate advanced air-delivered munition airframes, thereby improving sortic effectiveness and increasing strike aircraft load-outs. Develop a fuzing capability that will transmit function data from penetrating weapons through various hard target mediums. (U) In FY 2007: Further designed a hard target influence fuze capable of denying hard and deeply buried facilities access. Complete developing fuzes that can transmit bomb damage information to an aircraft platform. (U) In FY 2008: Complete initial phase of hard target influence fuze development and testing. Begin developing an active imaging target device that can provide warhead aimpoint selection for mass focused warheads. (U) In FY 2009: Continue developing an active imaging target device that can provide warhead aimpoint selection for 								<u>FY 2009</u> 2.758		
 (U) (U) MAJOR THRUST: Develop and demonstrate conventional munition subsystem and platform integration (U) MAJOR THRUST: Develop and demonstrate conventional munition subsystem and platform integration (U) MAJOR THRUST: Develop and demonstrate conventional munition subsystem and platform integration (U) MAJOR THRUST: Develop and demonstrate conventional munition subsystem and platform integration (U) In FY 2007: Completed a miniaturized datalink flight demonstration. Enhanced plans and begin design of a low-cost miniature cruise missile. Matured plans and began design of a miniature persistent munition that will 							0.312	0.267		
	control technologies activity in this project	not capability.	note: Datalink	angnt test cor	naucted in the na	avigation and				
Proj	ect 670A			R-1 Line Iter Page-2	m No. 27 of 6				Exhibit R-2a (I	PE 0603601F)
				416	6					

	Exhibit R-2a, RDT&E Project Just	DA	TE February	/ 2008		
BUDG 03 A	BET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development			
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Begin development of a small powered short-range precision-guided s multiple moving targets	ubmunition capable of attacking	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U)	In FY 2009: Begin developing a missile with the capability to defeat a broad range targets as well as high value ground targets, such as enemy as air defenses.	of small and highly agile air				
(U) (U)	MAJOR THRUST: Develop and demonstrate advanced conventional armament wa heavy metal liners, dense metal cases, and insensitive explosives with increased ene attributes. The goal of these efforts is to destroy hardened targets by more effective and by enhancing kill mechanisms against softer surface targets.	arhead technologies, including orgy release performance ly penetrating protective surfaces	6.823	6.949	3.269	
(U)	In FY 2007: Completed insensitive explosive warhead fills that significantly reduce Further developed an ordnance package that will significantly improve counter air la and manned aircraft. Developed and tested systems needed for an ordnance package minimum far-field lethality. Further developed a multi-mode warhead package desi submunitions. Further developed a weapon system capable of dispensing payloads applications.	e fill volume requirements. ethality against cruise missiles e with low collateral damage and igned for precision-guided within a target for counterforce				
(U)	In FY 2008: Extend development of an ordnance package with improved counter-a missile and urban targets, as well as attacking a subset of ground targets to include e developing a multi-mode warhead package designed for precision guided submuniti	ir lethality to address cruise enemy air defenses. Continue ons.				
(U)	In FY 2009: Demonstrate an ordnance package with improved counter-air lethality counter-air targets, as well as attacking a subset of ground targets to include enemy multi-mode warhead package designed for precision guided submunitions.	to address cruise missile and air defenses. Demonstrate a				
(U) (U)	MAJOR THRUST: Develop and demonstrate advanced conventional armament see munitions applications. These seeker technologies will autonomously detect, acquir in adverse weather and battlefield conditions. Also, the seeker technologies will inc minimize collateral damage, while providing increased weapons load-out and impro 2007, the Miniature Navigator Demonstration (in another thrust in this project) will for two different munition concerts to be initiated	eker technologies for miniature re, and guide to targets of interest crease the probability of kill and oved sortie effectiveness. In FY be completed allowing seekers	7.629	6.130	5.519	
(U)	In FY 2007: Designed, fabricated, and commenced ground and flight testing of a lo ranging seeker that reduces moving parts compared to earlier generation seekers. M a small multiple-mode radar for an air to surface weapon demonstration. Developed	ow-cost laser detection and latured plans and began designing d ordnance package designed for				
Proj	ect 670A R-1 Line Page	Item No. 27 e-3 of 6		Exhibit R-2a	(PE 0603601F)	

	Exhibit R-2a, RDT&E Project Jus	stification	DATE February 2008				
BUDG 03 A	BET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology	PROJECT NU 670A Con Developm	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development			
(U)	B. Accomplishments/Planned Program (\$ in Millions) low collateral damage and minimum far-field lethality.		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U)	In FY 2008: Continue design and demonstration of low cost laser detection and ra and reduce moving parts compared to earlier generation laser seeker technologies. seeker capable of engaging both moving and stationary targets in adverse weather.	nging seeker to increase data rates Develop a multi-mode radar					
(U)	In FY 2009: Continue design and demonstration of a low cost laser detection ordn and LADAR moving parts compared to earlier generation LADAR seeker technologicate radar seeker capable of engaging both moving and stationary targets in adverse we	ance seeker to increase data rates ogies. Flight test a multi-mode ather.					
(U) (U)	MAJOR THRUST: Develop and demonstrate advanced conventional armament nation increase armament navigation accuracy, improve stand off range, and enhance we electronic jamming environments. In FY 2007, the Miniature Navigator Demonstrate seekers for two different munition concepts to be initiated (in another thrust in this	avigation and control technologies reapons control and operation in ation will be completed allowing project).	1.626	0.000	0.000		
(U)	In FY 2007: Completed design and fabrication of a weapon datalink and integrated for commencement of flight testing.	datalink into a guided munition					
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U) (U)	CONGRESSIONAL ADD: Air Force Special Ops Innovative Miniature Infrared O In FY 2007: Conducted Congressionally-directed effort for Air Force Special Ops Camera.	Camera. Innovative Miniature Infrared	1.363	0.000	0.000		
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U)	CONGRESSIONAL ADD: Clandestine Electric Reconnaissance Vehicle (CERV) Command (AFSOC).	for Air Force Special Operations	3.116	0.000	0.000		
(U) (U) (U)	In FY 2007: Conducted Congressionally-directed effort for CERV for AFSOC. In FY 2008: Not Applicable. In FY 2009: Not Applicable.						
(U) (U) (U)	CONGRESSIONAL ADD: Micro-Sized Air-Launched Atmospheric Visibility Se In FY 2007: Conducted Congressionally-directed effort for Micro-Sized Air-Laun	nsor. ched Atmospheric Visibility	1.363	0.000	0.000		
Proj	ect 670A R-1 Line Pag	e Item No. 27 je-4 of 6		Exhibit R-2a	(PE 0603601F)		

	Exhibit R-2a, RDT&E Project Justi	DA	TE February	/ 2008		
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603601F Conventional Weapons Technology	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development			
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
an	Jn EV 2008: Not Applicable					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Falcon Eye Seeker		1.947	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effert for Falcon Eye Seeker.					
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Ground Mobile Gateway System.		1.363	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Ground Mobile Gateway	y System.				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)			2 502	0.000	0.000	
(U) (U)	CONGRESSIONAL ADD: Under Vehicle Mobile Inspection.		3.503	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for Under Vehicle Mobile in	ispection System.				
(\mathbf{U})	In FY 2008: Not Applicable.					
(0)	III F I 2009: Not Applicable.					
(0)	CONGRESSIONAL ADD: Next Generation Fixed Wing S-3B Heavy Aerial Firefig	hting Tanker	3 1 1 6	0.000	0.000	
	In FY 2007: Conducted Congressionally-directed effort for Next Generation Fixed V	Ving S-3B Heavy Aerial	5.110	0.000	0.000	
(0)	Firefighting Tanker	ing 5 5D Hoavy Honar				
ധ	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Unmanned Air Vehicle (UAV) Sensor Interface and Pay	loads for Targeting.	1.363	0.000	0.000	
(U)	In FY 2007: Conducted Congressionally-directed effort for UAV Sensor Interface an	nd Payloads for Targeting.				
(U)	In FY 2008: Not Applicable.					
(U)	In FY 2009: Not Applicable.					
(U)						
(U)	CONGRESSIONAL ADD: Weapons Data Link.		1.363	0.000	0.000	
Drei	R-1 Line It	em No. 27				
Pro	Ale Page-	<u>0</u>		Exhidit K-2a	(FE 0003001F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008	
BUD 03 /	GET ACTIVITY Advanced Technology Developm	ent (ATD)			PE NUMBER AND TITLE 0603601F Conventional Weapons Technology			PROJECT NUM 670A Conve Developmen	PROJECT NUMBER AND TITLE 670A Conventional Weapons Development		
(U) (U) (U)	B. Accomplishments/Planned Pro In FY 2007: Conducted Congressio In FY 2008: Not Applicable.	gram (\$ in Mil nally-directed e	<u>lions)</u> effort for Weapo	ons Data Link.				<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U) (U) (U) (U) (U)	In FY 2009: Not Applicable. CONGRESSIONAL ADD: Moving In FY 2007: Not Applicable. In FY 2008: Conduct Congressiona In FY 2009: Not Applicable.	g Target Strike. lly-direct effort	for Moving Ta	rget Strike.				0.000	1.589	0.000	
(U) (U)	Total Cost							38.602	18.379	11.813	
(U) (U) (U) (U)	C. Other Program Funding Summ Related Activities: PE 0602602F, Conventional Munitions. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.	ary (\$ in Millia <u>FY 2007</u> <u>Actual</u>	pns) 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> Estimate	<u>FY 2013</u> <u>Estimate</u>	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>	
Pro	ject 670A			R-1 Line Pag	e Item No. 27 ge-6 of 6				Exhibit <u>R-2a</u>	(PE 0603601F)	
				UNCL	420 ASSIFIED						

PE NUMBER: 0603605F PE TITLE: Advanced Weapons Technology

	Exhit	DATE	February	2008						
BUDGE 03 Ad	T ACTIVITY vanced Technology Development (PI 0	E NUMBER AND 603605F Adv	TITLE anced Weap	ons Technolo	ogy				
	Cost (\$ in Millions)	FY 2007 Actual	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	74.683	74.383	44.507	48.530	43.000	48.961	56.415	Continuing	TBD
11SP	Advanced Optics and Laser Space Tech	20.598	38.243	16.586	17.053	16.591	16.641	16.684	Continuing	TBD
3150	Advanced Optics Technology	11.690	11.524	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
3151	High Power Solid State Laser Technology	26.206	14.186	19.623	15.003	10.681	19.264	26.954	Continuing	TBD
3152	High Power Microwave Technology	12.551	10.430	8.298	16.474	15.728	13.056	12.777	Continuing	TBD
3647	High Energy Laser Technology	3.638	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 transferred 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 components/techniques are also demonstrated. In high power microwaves, technologies such as narrowband and wideband devices and antennas are demonstrated. Note: In FY 2008, Congress added \$1.9 million for All Electric Laser, \$8.4 million for Applications of LIDAR to Vehicles with Analysis (ALVA), \$1.6 million for Real-time Optical Surveillance Applications, \$2.4 million for the Satellite Active Imaging National Testbed Program, \$15.0 million for Space Situational Awareness Research, and \$1.6 million for Compound Zoom for Airborne Reconnaissance (CZAR). 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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	Exhibit R-2, RDT&E Bu	DATE Februa	ry 2008		
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced	Weapons Technolog	IY	•
(U)	B. Program Change Summary (\$ in Millions)				
			<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	Previous President's Budget		76.733	43.999	38.877
(U)	Current PBR/President's Budget		74.683	74.383	44.507
(U)	Total Adjustments		-2.050	30.384	
(U)	Congressional Program Reductions			-0.026	
	Congressional Rescissions			-0.490	
	Congressional Increases			30.900	
	Reprogrammings		-0.347		
	SBIR/STTR Transfer		-1.703		
(U)	Significant Program Changes:				
	Funding was increased in FY 2009 for additional demonstrations le	eading to an earlier transition of factical dire	ected energy weapon tech	hnologies.	
	C. Derformence Matrice				
	C. Performance Metrics				
	Under Development.				
		K-1 Line Item No. 28 Page-2 of 19		Exhibit F	2-2 (PE 0603605E)
		<i>A</i> 22			

	Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUD(03 A	GET ACTIVITY dvanced Technology Development ((ATD)		P 0 T	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology			PROJECT NUMBER AND TITLE 11SP Advanced Optics and Laser Space Tech		
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
11SI	Advanced Optics and Laser Space Tech	20.598	38.243	16.586	17.053	16.591	16.641	16.684	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
Note	: In FY 2007, efforts transferred from PE (0603500F, Multi	disciplinary A	dvanced Devel	opment Space '	Technology, Pr	oject 5031, A	dvanced Optics	and Laser Spac	e
Tech	nology, in order to more effectively manag	ge and provide ov	versight of the	efforts.						
(U)	A. Mission Description and Budget Item	<u>Justification</u>								
	This project provides for the demonstration	n and detailed as	sessment of sp	ace unique tec	hnologies need	ed for advanced	d optical and I	aser systems.		
(U)	B. Accomplishments/Planned Program	(\$ in Millions)					FY	<u> 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
 (U) MAJOR THRUST: Develop and demonstrate advanced, long-range optical technologies such as advanced beam 1.186 (U) MAJOR THRUST: Develop and demonstrate advanced, long-range optical technologies such as advanced beam 1.186 (U) In FY 2007: Performed cost trade studies and commenced design of integrated testbed. Developed laboratory setup to test performance of a deformable mirror system. 							1.186	1.060	0.937	
(0)	power, advanced thermal management, si	gnal processing	sensors, and c	ptical testbed a	g and vibration	i control.)			
(U)	In FY 2009: Continue integration of test	bed and begin te	sting of sub-sy	stems.	8					
(U)										
(U)	MAJOR THRUST: Perform atmospheric applications using large aperture telescop characterization of small/dim space object	c compensation/les, including hights, and high accurate	beam control ex sh-resolution sa aracy space ob	xperiments for atellite imaging ject tracking.	space situation g, detection and	al awareness		5.453	4.317	3.322
(U)	 U) In FY 2007: Demonstrated detection and discrimination of small, non-resolved space objects. Demonstrated visible and near-infrared imaging of satellites too small or dim for present systems. Began detailed design, simulation, and component specification of high efficiency adaptive optics system for compensated visible imaging and detection of users and the space objects. Demonstrated and energy imaging for large aparture high resolution to head on the space object. 									
(U)	(U) In FY 2008: Continue design and begin subsystem integration of high efficiency adaptive optics system for compensated imaging and detection of very dim space objects at visible and near infrared wavelengths. Perform laboratory tests to validate the performance of lightweight mirrors.									
(U)	In FY 2009: Integrate high efficiency ad	aptive optics sys	tem on large a	perture high res	solution telesco	ope. Perform				
	system tests and prepare for demonstration objects at visible and infrared wavelength	ons of high resolutions. Conclude ph	ition compense ased array ima	ated imaging an ging experimer	nd detection of nts.	very dim space	2			
Proj	ect 11SP			R-1 Line Iten Page-3 c	n No. 28 of 19				Exhibit R-2a (PE 0603605F)

	February	y 2008					
BUD(03 A	GET ACTIVITY Idvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT N 11SP Adv Space Te	PROJECT NUMBER AND TITLE 11SP Advanced Optics and Laser Space Tech			
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>		
(U) (U)	MAJOR THRUST: Develop and demonstrate advanced optical beam contract through severe and/or extended atmospheric turbulence.	ol technologies for laser propagation	13.959	15.580	12.327		
(U)	In FY 2007: Began integration of advanced ground diagnostic system for cl through atmospheric turbulence. Demonstrated and characterized operation technologies in stressing atmospheric conditions.	haracterization of laser propagation of advanced adaptive optics and tracking					
(U)	In FY 2008: Continue integration of advanced ground diagnostic system fo through stressing atmospheric turbulence. Perform laboratory characterization wavefront control technologies.	r characterization of laser propagation ion on components for sensing and					
(U)	In FY 2009: Complete design and begin to build advanced ground diagnost propagation through atmospheric turbulence in a variety of atmospheric con of advanced sensing and wavefront control technologies.	tic system performance of laser aditions. Conduct brassboard integration					
(U) (U) (U)	CONGRESSIONAL ADD: Space Situational Awareness. In FY 2007: Not Applicable.	closies to advance space situational	0.000	14.902	0.000		
(0)	awareness. Improve the performance of current collection, analysis, fusion, technologies for satellite modeling and assessment. Develop tools for analy and demonstrate resolved and non-resolved satellite imaging concepts. Develop and demonstrate space-object identification tech algorithms.	and dissemination capabilities. Develop rsis, modeling, and simulation. Develop relop and demonstrate passive and active hniques. Develop image processing					
(U)	In FY 2009: Not Applicable.						
(U) (U)	CONGRESSIONAL ADD: Satellite Active Imaging National Testbed (for Testbed (GLINT)).	merly GEO Light Imaging National	0.000	2.384	0.000		
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Develop active imaging technologies for meeting space active	awareness spatial resolution goals from					
(U)	user community. In FY 2009: Not Applicable.		20 500	20.242	16 506		
(U)	I otal Cost		20.598	38.243	16.586		
Pro	ect 11SP	R-1 Line Item No. 28 Page-4 of 19		Exhibit R-2a	(PE 0603605F)		

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008
BUD 03	GET ACTIVITY Advanced Technology Developi		PE NUMBER AND TITLE 0603605F Advanced Weapons Technology			PROJECT NUMBER AND TITLE 11SP Advanced Optics and Laser Space Tech			
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	ons)						
		<u>FY 2007</u> Actual	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimate	FY 2013 Estimate	Const to Complete Total Cost
(U)	PE 0602605F, Directed Energy Technology								
(U)	PE 0603444F, Maui Space Surveillance System								
(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								
(U)	PE 0602624A, Weapons and Munitions Technology								
(U)	PE 0603004A, Weapons and Munitions Advanced Technology								
(U)	PE 0602114N, Power Projection								
(U)	PE 0602702E, Tactical								
(U)	PE 0603175C, Ballistic Missile								
(U)	PE 0603883C, Ballistic Missile								
(U)	PE 0602651M, Joint Non-Lethal								
Pro	pject 11SP			R-1 Line Pag	e Item No. 28 e-5 of 19				Exhibit R-2a (PE 0603605F)
					425				

Exhibit R-2a, RDT	Exhibit R-2a, RDT&E Project Justification									
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NUMBER AND TITLE 11SP Advanced Optics and Laser Space Tech								
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Weapons Applied Research. (U) PE 0603651M, Joint Non-Lethal Weapons Technology Development. (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. 										
Project 11SP	R-1 Line Item No. 28 Page-6 of 19 426	Exhibit R-2a (PE 0603605F)								
	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	fication			DATE	February	2008
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BUDG 03 Ac	ET ACTIVITY dvanced Technology Development (ATD)		F -	PE NUMBER AND 0603605F Adv Technology	TITLE anced Weap	ons	PROJECT NUMI 3150 Advanc	BER AND TITLE ed Optics Te	chnology
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
Exhibit R-2a, RDT&E Project Justification Date February 2 BUDGET ACTIVITY BUDGET ACTIVITY PR NUMBER AND TITLE 06030057 Advanced Weapons Technology PROJECT NUMBER AND TITLE 06030057 Advanced Veapons Technology PROJECT NUMBER AND TITLE 0000 0.0.000 Outool O.0000 0.0000 Outool O.0000 0.0000 Outool O.0000 0.000 Outool O.0000 0.000 Outool O.0000 0.0000 Outool O.0000 0.000 Outool O.0000 0.0000 Outool O.0000 0.0000 Outool O.0000 Outool O.0000 0.0000 Outool O.0000 Outool O.0000										
3150	Advanced Optics Technology	11.690	11.524	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
(U) <u>4</u> (U) (U)	 A. Mission Description and Budget Item This project develops advanced optical tech B. Accomplishments/Planned Program CONGRESSIONAL ADD: Near Earth S 	<u>Justification</u> hnologies for va (\$ in Millions) pace Surveilland	rious strategic ce Initiative (N	and tactical b	eam control app	lications.	<u>FY</u>	<u>7 2007</u> 1.559	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U) (U) (U) (U) (U) (U) (U) (U)	 U) In FY 2007: Continued development of the wide held corrector, the prime focus instrument package, and the tracker system. U) In FY 2008: Not Applicable. U) U) CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrated Experiments. U) U) CONGRESSIONAL ADD: Mobile Active Targeting Resource for Integrated Experiments. U) In FY 2007: Successfully completed missile detection and tracking at Tonopah Test Range. Designed, fabricated and integrated system upgrades to improve performance against man portable air defense systems (MANPADS). Demonstrated performance improvements. U) In FY 2008: Not Applicable. U) In FY 2009: Not Applicable. 									
(U) (U) (U) (U) (U)	 I) CONGRESSIONAL ADD: Hyper/multispectral Data Reduction and Archiving (HyDRA) Project. In FY 2007: Developed advanced change and anomaly detection algorithms to significantly enhance targeting capability of tactical laser weapons. Developed system requirements and plans for integration to legacy systems. Demonstrated ability to automatically extracted target signatures from background clutter. In FY 2008: Not Applicable. In FY 2009: Not Applicable. 									0.000
(U) (U) (U)	CONGRESSIONAL ADD: Applications In FY 2007: ALVA consists of two effort airborne night-time imaging to support mi Demonstrated military utility of lasers for sensors into real-world air frames. Condu	of LIDAR to V s: Standoff Intel issions such as of night-time vide acted proof of co	ehicles with A ligence Design counter-improve o including fli oncept demons	nalysis (ALV) nator (SID) and vised explosive ght testing, int trations for co	A). d Hi-Class. SID e device detection tegrating state-of mmunications n	b: Developed on. f-the-art etworks and		6.624	8.346	0.000
Proje	ect 3150			R-1 Line Ite Page-7 ⊿2	m No. 28 of 19 7				Exhibit R-2a (I	PE 0603605F)

	Exhibit R-2a, RDT&E Project Just	lification	DA	TE February	2008
BUD(03 A	ET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NU 3150 Adva	JMBER AND TITLE	echnology
(U)	B. Accomplishments/Planned Program (\$ in Millions) evaluation studies. Hi-Class: Conducted initial testing of the three-dimensional sen for imaging/detection of small/dim space objects for space situational awareness and Altered the Hi-Class laser setup to ensure better reliability, maintainability, and supp	sor in a two-dimensional mode I missile tracking applications. port to customers.	FY 2007	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: SID: Complete testing of active nighttime imagers and prepare to trans Develop smaller, lighter laser imagers for new customers. Evaluate potential for usi sensors for different applications. Hi-Class: Continue integration and undertake test capability for imaging/detection of small/dim space objects. Integrate a hyperspectr system.	ition technology to customers. Ing continuous-wave laser ing of the three-dimensional al imager into the Hi-Class			
(U)	In FY 2009: Not Applicable.				
(U) (U) (U)	CONGRESSIONAL ADD: Real-time Optical Surveillance Applications (ROSA). In FY 2007: Developed detailed simulations involving physics-based model for tim to study the benefits and limitations of the sensor in potential space situational awar advanced observatory control architecture for maximum reliability yet flexible enou missions and compliant with security requirements.	e-resolved photon counter sensor eness applications. Developed gh to accommodate diverse	1.559	1.589	0.000
(U) (U)	In FY 2008: Leverage previously developed models to exploit unique capabilities of for detection of extremely small or faint objects. Conduct modeling and simulation capabilities in change detection with optical sensors. Pursue artificial intelligence p telescope networks for space situational awareness mission. In FY 2009: Not Applicable.	f time-resolved photon counter studies to push current aradigm in automation of			
(U) (U) (U)	CONGRESSIONAL ADD: Compound Zoom for Airborne Reconnaissance (CZAR In FY 2007: Not Applicable.	.).	0.000	1.589	0.000
(U)	In FY 2008: Develop requirements and provide designs for all hardware and softward demonstrate a commercial high quality compact compound zoom lens for application Conduct a study to evaluate multiple sensors (cameras). Use modeling and simulatic control.	re modifications to adapt and n on an Air Force gunship. on to develop robust stabilization			
(U) (U)	In FY 2009: Not Applicable. Total Cost		11.690	11.524	0.000
Proi	ect 3150 R-1 Line Page	tem No. 28 -8 of 19		Exhihit R-2a	(PE 0603605E)
	4	28			

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008
BUD 03	GET ACTIVITY Advanced Technology Develop	oment (ATD)			PE NUMBER A 0603605F A Technology	ND TITLE dvanced Wea	pons	PROJECT NUME 3150 Advanc	BER AND TITLE ed Optics Technology
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons)</u>						
		<u>FY 2007</u> <u>Actual</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> <u>Total Cost</u>
(U) (U)	Related Activities: PE 0603444F, Maui Space Surveillance Systems.								
(U)	PE 0602605F, Directed Energy Technology.								
(U)	This project has been coordinated through the								
	harmonize efforts and eliminate duplication.								
(U)	D. Acquisition Strategy Not Applicable.								
Pro	ject 3150			R-1 Line Pag	e Item No. 28 e-9 of 19				Exhibit R-2a (PE 0603605F)
				UNCL	429 Assified				

	Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUD(03 A	GET ACTIVITY dvanced Technology Development	P 0 T	E NUMBER AND 603605F Adv echnology	anced Weap	ons	PROJECT NUMBER AND TITLE 3151 High Power Solid State Laser Technology				
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3151	High Power Solid State Laser Technology	26.206	14.186	DATE February 2008 PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT NUMBER AND TITLE 3151 High Power Solid State Light Constraints FY 2008 FY 2010 FY 2011 FY 2012 FY 2013 Cost to T Estimate Estimate Estimate Estimate Estimate Estimate Complete T 14.186 19.623 15.003 10.681 19.264 26.954 Continuing 0 0 0 0 0 0 0 0 0 anstration, and detailed assessment of low to high power laser and beam control technologies needed for on engagement, and Global War on Terrorism missions. Critical technologies developed and user devices with good beam quality and scalability to high power; (2) advanced optics and laser beam laser radiation through the atmosphere to a target. Emphasis will be on demonstrating the ability to meet dability, and packaging requirements unique to potential applications. Perform laser system concepts flect testing. Identify critical design data for laser system concepts. Develop high energy laser system ectures, technology readiness, technologies for a tated, chemical, gas, and hybrid laser technologies for e tactical and strategic applications and ground-based Y2007 FY 2008 FY 1022 FY 2007 FY 2008 FY 2008 FY 2007 FY 2008 FY 2008 FY 2009	TBD					
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project provides for the development aircraft protection, force protection, force demonstrated include: (1) compact, reliab control components to effectively compen- key system concept performance parameter assessments to include vulnerability asses concepts and identify issues relating to sys-	t, integration, der application, prec le, and affordabl isate and propaga ers, reliability, af sments and targe stem concept arc	nonstration, an rision engagem e laser devices ate laser radiati fordability, and t effect testing hitectures, tech	d detailed asse aent, and Globa with good bear on through the d packaging red . Identify critic mology reading	ssment of low t I War on Terror m quality and so atmosphere to quirements unic cal design data ess, technology	o high power la rism missions. calability to hig a target. Emph que to potential for laser systen tradeoffs, miss	aser and beam Critical techn gh power; (2) a aasis will be on applications. n concepts. De ion effectiven	control technologies develop advanced optics n demonstrating Perform laser s evelop high energiess, and military	ogies needed fo ed and and laser beam the ability to m ystem concept rgy laser system v utility.	or 1 neet n
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop, integrate, a scalable, high energy laser devices for in laser system concepts.	n (\$ in Millions) and demonstrate sertion into airbo	solid state, che orne tactical an	emical, gas, and d strategic appl	l hybrid laser te lications and gr	chnologies for ound-based	<u>F</u> Y	<u>7 2007</u> 3.789	<u>FY 2008</u> 1.022	<u>FY 2009</u> 2.315
(U)	In FY 2007: Scaled solid state lasers with quality, and run time. Investigated integ- advanced thermal management systems, transition. Investigated tactical laser app customer interaction.	h a goal of reach rating the laser to avionics, sensors blications. Demo	ing weapons-cl echnology with s, and fire cont nstrated tactica	lass parameters a tactical platfor rol to increase t al laser utility th	including pow rm sub-systems the potential for hrough field ex	er, beam such as power r successful periments and	,			
(U)	In FY 2008: Develop solid state lasers for space situational awareness (e.g. active to weapons-class power, beam quality, and technology insertion in airborne systems efficiency, affordability, reliability, main ruggedness. Investigate integrating laser advanced thermal management systems, transition.	or a wide set of a racking and imag run time capabil . These technolo ttainability, supp device technolo avionics, sensors	applications inc ging) with a go ities. Develop ogies will reduc ortability, oper gy with tactica s, and fire cont	cluding tactical al of exceeding technologies to be laser size and ational environ l platform sub- rol to increase	weapons, self-o g the thresholds o support solid d weight, as we umental accepta systems such a the potential for	defense, and for state laser ll as increase bility, and s power, r successful				
(U)	In FY 2009: Continue to simulate, build tactical weapons and space situational av	, and evaluate so vareness applicat	lid state lasers ions (i.e. active	for a variety of e track, active i	f applications su maging, illumi	uch as airborne nation).				
Proj	ect 3151			R-1 Line Iten Page-10	n No. 28 of 19				Exhibit R-2a (F	PE 0603605F)
				430)					

	Exhibit R-2a, RDT&E Project	Justification	D	ATE February	/ 2008
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PROJECT N 3151 Higi Technolo	NUMBER AND TITLE IN Power Solid S Igy	State Laser	
(U)	B. Accomplishments/Planned Program (\$ in Millions) Continue to focus on reducing size and weight, as well as increasing efficience maintainability, supportability, operational environmental acceptability, and r integration of laser technology with tactical platform sub-systems such as pow systems, avionics, sensors, and fire control to increase the potential for success of appropriate laser technologies for a large aircraft demonstration of solid states.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Develop, integrate, and demonstrate advanced optical and systems concepts. Develop and demonstrate integrated tactical laser and bear include optical components, optical coatings, advanced beam control, atmosp tracking. Analyze system concepts and perform critical experiments with integrated technologies. Funding was increased in FY 2009 for additional integrated der transition of tactical airborne laser and beam control technologies.	11.020	11.276	17.308	
(U)	In FY 2007: Acquired a solid state laser for an integrated high energy laser te systems. Began integration experiments to focus on architectures favorable in affordability, reliability, maintainability, supportability, operational environm tactical weapon applications. Began facility and support equipment modificat testbed.	estbed that can use various beam control in terms of size, weight, efficiency, intental acceptability, and ruggedness for tions for integrated high energy laser			
(U)	In FY 2008: Upgrade existing facility, integrate solid state laser device into f checkout. Demonstrate advanced tactical beam control hardware components beam control concepts in integrated simulations. Begin development of the se demonstrator including the telescopes, the optics, the associated gimbals, the electronics.	acility, and conduct initial testbed s in the laboratory. Analyze advanced econd-generation tactical relay mirror lightweight optics bench, and			
(U)	In FY 2009: Begin upgrade of the integrated high energy laser testbed and performance objectives. Demonstrate integrated tactical laser and beam contributed tactical beam control field tests to optimize advanced active tracking algorithms breadth of environments for airborne tactical laser engagements. Complete the second-generation relay mirror demonstrator. Demonstrate the use of the second solid state laser testbed in the laboratory.				
(U) (U) (U)	CONGRESSIONAL ADD: Mid-Infrared Semiconductor Laser Technology. In FY 2007: Provided environmental hardening for a low-cost, multi-band, c	compact, robust, lightweight	1.656	0.000	0.000
Proj	ject 3151	1 Line Item No. 28 Page-11 of 19 431		Exhibit R-2a	(PE 0603605F)

	Exhibit R-2a, RDT&E Projec	t Justification	DA	TE February	/ 2008
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT NU 3151 High Technolog	JMBER AND TITLE Power Solid S JY	tate Laser
(U)	B. Accomplishments/Planned Program (\$ in Millions) semiconductor laser demonstration system capable of jamming infrared miss capability. Incorporated and fiber-coupled the advanced high-brightness inf pod-mounted infra-red countermeasure.	siles with both open and closed loop ra-red semiconductor lasers for a	<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.				
(U) (U) (U) (U)	CONGRESSIONAL ADD: High Energy Laser- Directed Energy Weapon S In FY 2007: Performed trade studies to enhance the scalability of the ceram In FY 2008: Not Applicable. In FY 2009: Not Applicable.	2.338	0.000	0.000	
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Advanced Weapons and Laser Diode Developm In FY 2007: Continued to refine fiber-coupling and improved manufacturin diodes. In FY 2008: Not Applicable. In FY 2009: Not Applicable.	nent. g and packaging concepts of laser	2.533	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: Lightweight Multi-purpose Laser. In FY 2007: Improved epitaxial growth and processing to improve yield and packaging to improve reliability. Extended high efficiency designs into add In FY 2008: Not Applicable. In FY 2009: Not Applicable.	d cut costs. Improved device layout and itional wavelength ranges.	4.870	0.000	0.000
(U) (U) (U) (U) (U)	CONGRESSIONAL ADD: All Electric Laser. In FY 2007: Not Applicable. In FY 2008: Develop electric laser technologies for airborne applications. In FY 2009: Not Applicable.		0.000	1.888	0.000
(U)	Total Cost		26.206	14.186	19.623
Proj	ect 3151	R-1 Line Item No. 28 Page-12 of 19 432		Exhibit R-2a	(PE 0603605F)

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008
BUD 03 /	GET ACTIVITY Advanced Technology Developi	ment (ATD)			PE NUMBER A 0603605F A Technology	ND TITLE .dvanced Wea /	pons	PROJECT NUM 3151 High P Technology	BER AND TITLE ower Solid State Laser
(U)	C. Other Program Funding Sumr	<u>mary (\$ in Milli</u>	ons)						
		<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
an	Related Activities:	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete
(U)	PE 0602102F Materials								
(U)	PE 0603270F. Electronic								
(-)	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								
(ID	Munitions Technology.								
(0)	Munitions Advanced								
	Technology								
an	PE 0602114N Power Projection								
(0)	Applied Research								
aD	PE 0603175C. Ballistic Missile								
(0)	Defense Technology								
(U)	PE 0603883C, Ballistic Missile								
Ì,	Defense Boost Phase Segment.								
(U)	PE 0602651M, Joint Non-Lethal								
Dre	viect 3151			R-1 Line	e Item No. 28				Evhibit R-22 (PE 06036055)
FIC				Fay	<u>4</u> 22		1		LAMUNIL IN-28 (FL 0003003F)
					100				

Exhibit R-2a, RDT&E Pr	oject Justification	DATE February 2008
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PROJECT NUMBER AND TITLE 3151 High Power Solid State Laser Technology	
 O3 Advanced Technology Development (ATD) (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Weapons Applied Research. (U) PE 0602651M, Joint Non-Lethal Weapons Applied Research. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. (U) The technology efforts in this PE that are supporting future enhancements to airborne lasers have been coordinated with the Airborne Laser program office. (U) <u>D. Acquisition Strategy</u> Not Applicable. 	0603605F Advanced Weapons Technology	3151 High Power Solid State Laser Technology
Project 3151	R-1 Line Item No. 28 Page-14 of 19 434	Exhibit R-2a (PE 0603605F)

	Ext	nibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008
BUDG 03 A	ET ACTIVITY dvanced Technology Development (ATD)		F C T	PE NUMBER AND 0603605F Adv Fechnology	TITLE anced Weap	ons	PROJECT NUME 3152 High Po Technology	BER AND TITLE	ve
	Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
Exhibit R-2a, RDT&E Project Justification DATE February 2008 BUDGET ACTIVITY OF ENUMBER AND TITLE 03 Advanced Technology Development (ATD) PROJECT NUMER AND TITLE 0603605F Advanced Weapons Technology PROJECT NUMER AND TITLE 3152 High Power Microwave Technology PROJECT NUMER AND TITLE 3152 High Power Microwave Technology Provident Attack 3152 High Power Microwave Technology 12.551 10.430 8.298 16.474 15.728 13.056 12.777 Continuing Quantity of RDT&E Articles 0 </td <td>TBD</td>			TBD							
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	This project develops and demonstrates hig as the potential disruption, degradation, da local computer and communication system collateral structural or human damage. In a vulnerability, and lethality data base to ider weapon system decisions. Representative narrowband (very small frequency range) t	gh power micro mage, or destru- s, as well as lar addition, millim ntify potential v U.S. and foreign echnologies are	wave (HPM) go ction of an adv ge and small ai leter wave force ulnerabilities on assets are test being develop	eneration and t ersary's electro r defense and e e protection te of U.S. systems ted to understa	transmission tec onic infrastructu command and c chnologies are c s to HPM threats nd real system s	hnologies that re and military ontrol systems. leveloped and c s and to provide susceptibilities.	support a wide capability. Th In many case lemonstrated. e a basis for fu Both wideba	e range of Air Fo hese targeted ca es, this effect can It also develop iture offensive a nd (wide freque	orce missions su pabilities incluc n be covert with os a susceptibilit and defensive ncy range) and	uch le 1 no ty,
(U) (U) (U) (U) (U)	Delet Advanced Technology Development (ATD) PENJMER AND TITLE 6003067 Advanced Weapons Technology PROJECT NUMBER AND TITLE 6003067 Advanced Weapons Technology									
(U) (U) (U)	MAJOR THRUST: Develop and evaluate weapon applications such as ground force In FY 2007: Developed and evaluated tec power millimeter-wave source for airborn Identified deficiencies and evaluated need Commenced hardware development for fu technical expertise and background to ext their needs and gleaned data relevant to air	e millimeter-wa protection from chnologies for m e applications. I to rebuild. Co all power source ernal organizati irborne applicat	ve Active Deni n a stand-off ai on-lethal weap Evaluated first mpleted critica e test stand incl ons tailoring A ions.	ial technologie rcraft. oons applicatio t phase conven l design review uding award o .ctive Denial c	es for non-lethal, ns. Continued t titonal source ap w for coaxial sou of test stand cont oncepts and cap	, anti-personnel o develop high proach. urce design. tract. Provided abilities to	l	5.747	3.768	4.429
Proje	ect 3152			Page-15	of 19				Exhibit R-2a (F	PE 0603605F)
				438	5					

	Exhibit R-2a, RDT&E Project J	ustification	DA	February	/ 2008
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PROJECT N 3152 High Technolo	UMBER AND TITLE Power Microw gy	ave	
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Continue to develop and evaluate technologies for non-lethal weap development of high power millimeter-wave source for airborne applications. F testing of the second version of the conventional gyrotron approach. Begin built Continue with hardware development, procurement, fabrication, and testing for Provide technical expertise and background to external organizations tailoring A capabilities to their needs and glean data relevant to airborne applications. In FY 2009: Continue to develop and evaluate technologies for non-lethal weap conventional or coaxial approaches arriving at best high power millimeter-wave development of millimeter-wave source for airborne applications in ground-base hardware development, procurement, fabrication, and testing for the full power s expertise and background to external organizations tailoring Active Denial conc and glean data relevant to airborne applications.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) (U)	MAJOR THRUST: Develop the technology to integrate HPM devices on variou investigate specific target sets of interest. Develop and demonstrate HPM technor detroy an advarcary's electronic systems	as platforms, to include aerial, and ologies to disrupt, degrade, damage,	5.856	6.068	3.869
(U)	In FY 2007: Continued miniaturization, integration, and ruggedization of HPM Examined the interactions of the HPM source, antenna, and pulse power to incree enhanced configuration for permanent magnets in relativistic magnetron and fab integration and began evaluating the HPM testbed to determine efficiency and p interference/coupling issues. Improved HPM testbed command and control sub-performance of the integrated gigawatt-class HPM source and antenna. Investig airborne platforms. Performed system diagnostics on integrated experiment to e	testbed for field experimentation. ease functionality. Investigated ricated source. Continued otential electromagnetic esystems. Demonstrated ated HPM system interaction with nsure proper source operation.			
(U)	In FY 2008: Integrate and ruggedize the HPM testbed for field experimentation diagnostics on hardware developed and integrated in FY 2007. Improve HPM to for pulsed operation greater than threshold levels.	Perform HPM system testing and estbed command and control systems			
(U)	In FY 2009: Conduct laboratory demonstration of the miniaturized and ruggedir system performance and address all electromagnetic interference issues. Implem command and control systems for expanded pulsed operation. Implement subco	zed HPM testbed. Enhance the nent the improved HPM testbed mponent improvements as			
(U)	Total Cost		12.551	10.430	8.298
Pro	ject 3152 R-1 L	ine Item No. 28 age-16 of 19 436		Exhibit R-2a	(PE 0603605F)

		DATE	February 2008							
BUD(03 A	GET ACTIVITY dvanced Technology Develop	ment (ATD)			PE NUMBER A 0603605F A Technology	ND TITLE Idvanced Wea	PROJECT NUME 3152 High Po Technology	PROJECT NUMBER AND TITLE 3152 High Power Microwave Technology		
(U)	C. Other Program Funding Sum	<u>mary (\$ in Millie</u>	ons)							
		<u>FY 2007</u> Actual	<u>FY 2008</u> 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>	
(U) (U) (U) (U) (U) (U) (U) (U)	Related Activities: PE 0602202F, Human Systems Technology. PE 0602605F, Directed Energy Technology. PE 0602120A, Sensors and Electronic Survivability. PE 0602624A, Weapons and Munitions Technology. PE 06026114N, Power Projection. PE 0602651M, Joint Non-Lethal Weapons Applied Research. PE 0603851M, Nonlethal Weapons. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy Not Applicable.									
Proi	ect 3152			R-1 Line Page	e Item No. 28 e-17 of 19				Exhibit R-2a (PE 0603605F)	
				. age	437					

E	Exhibit R-2a, RDT&E Project Justification ET ACTIVITY PE NUMBER AND TITLE PROJECT NUMBER AND Vanced Technology Development (ATD) DATE Febr Febr Febr Febr Febr Febr Febr Febr			February	2008				
BUDGET ACTIVITY 03 Advanced Technology Development	(ATD)		F ()	PE NUMBER AND 0603605F Adv Technology	anced Weap	ons	PROJECT NUM 3647 High E	IBER AND TITLE nergy Laser T	echnology
Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
3647 High Energy Laser Technology	3.638	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		
Note: In FY 2008, this effort moved into Proj	ect 3151 in this pr	ogram element	t to consolidate	e the laser devic	e development	efforts.			
(U) A. Mission Description and Budget Ite	<u>m Justification</u>								
focus is on airborne high energy laser mi Critical technologies developed and dem radiation through the atmosphere to a tar in most long-range high energy laser app developed.	ssions, although ti onstrated include get. Correcting th lications. Detaile	he technology advanced high le laser beam fo d computationa	developed for energy laser d or distortions i al models to es	this project is d levices and lase induced by prop stablish high end	r beam control agation through ergy laser weap	le to most hig to efficiently on the turbulent on effectivent	h energy laser compensate and atmosphere is ess and target v	applications. I propagate laser the key technolo ulnerability are	r ogy
 (U) <u>B. Accomplishments/Planned Program</u> (U) MAJOR THRUST: Develop and demo efficiency for insertion in tactical airbon (U) In FY 2007: Tested overall device-leve concepts and increased mass flow from determined performance increases. Inv systems. (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 	m (\$ in Millions) nstrate the techno- ne lasers and othe l performance and singlet-oxygen ge estigated systems	logy for scalab or potential wea l issues based of enerators into a performance o	le, high energy apon application on the integration laser device. f airborne cher	y laser devices v ons. ion of the ejecto Tested advance mical oxygen io	with improved or nozzle d fuels and dine laser	EY	<u>7 2007</u> 1.690	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
 (U) CONGRESSIONAL ADD: Laser Spar (U) In FY 2007: Performed laboratory effective threshold of different focal plane arrays selected operational scenarios. (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 	k Countermeasure cts tests and mode . Performed and o	Program. ling to resolve locumented a c	measured diff countermeasur	ferences in the d re effectiveness	lamage study for		1.948	0.000	0.000
(U) Total Cost							3.638	0.000	0.000
Project 3647			R-1 Line Iter Page-18 438	m No. 28 of 19 8				Exhibit R-2a (I	PE 0603605F)
				SIFIED					

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February 2008	
BUD 03	GET ACTIVITY Advanced Technology Develop	ment (ATD)			PE NUMBER A 0603605F A Technology	ND TITLE dvanced Wea	pons	PROJECT NUMBER AND TITLE 3647 High Energy Laser Technology		
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	<u>ons)</u>							
		<u>FY 2007</u> <u>Actual</u>	<u>FY 2008</u> <u>Estimate</u>	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 Cost</u>	
(U) (U) (U) (U)	Related Activities: PE 0602605F, Directed Energy Technology. PE 0603883C, Ballistic Missile Defense Boost Phase Segment. This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. The technology efforts in this PE that are supporting future enhancements to airborne lasers have been coordinated with the									
(U)	Airborne Laser program office. D. Acquisition Strategy Not Applicable.									
Pro	ject 3647			R-1 Line Page	e Item No. 28 e-19 of 19				Exhibit R-2a (PE 0603605F)	
					439					

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PE NUMBER: 0603680F PE TITLE: Manufacturing Technologies

	Exhib	it R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008	
BUDGE 03 Adv	T ACTIVITY vanced Technology Development (<i>i</i>	ATD)		PI 0	E NUMBER AND 603680F Man	TITLE	echnologies				
	Exhibit R-2, RDT&E Budget Item Justification DATE T ACTIVITY To CTIVITY Description Descript										
	Cost (\$ III MIIIIOIIS)	Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete		
	Total Program Element (PE) Cost	0.000	0.000	39.729	40.480	40.865	41.653	42.493	0.000	0.000	
5280	Manufacturing Technologies	0.000	0.000	35.756	36.432	36.779	37.488	38.244	0.000	0.000	
5281	Manufacturing Readiness	0.000	0.000	3.973	4.048	4.086	4.165	4.249	0.000	0.000	
on long (U) <u>A</u> TI re	g-term manufacturing and processes. Mission Description and Budget Item the ManTech program is mandated by Sec esponsive to the warfighter's needs. The A	Justification tion 2521, Title	10, United Sta	ates Code, to cr gram tenets are:	eate an afforda development a	ble, world-class	s industrial base	e manufacturin	g capability ses; collaborati	on	
re to qu la th A m	reasonable risk level for industry alone; cost-sharing; multiple system/customer applications; potential for significant return on investment; and customer commitment to implement. To this end, ManTech develops, demonstrates, assesses and transitions advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. Where mature processes are not available, laboratory-developed and demonstrated process capabilities are make available for transition into weapon system programs. ManTech objectives are conducted through partnerships with all industry levels, from large prime contractors to small material and parts vendors. Manufacturing Technologies is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates manufacturing technologies for existing upgrades and/or new system developments that have military utility and address warfighter needs.										
(U) <u>E</u>	3. Program Change Summary (\$ in Mill	lions)					<u>FY 2007</u>	<u>FY 2</u>	2008	<u>FY 2009</u>	
(U) P	Previous President's Budget										
(U) C	Current PBR/President's Budget						0.000	0	.000	39.729	
(U) T	Fotal Adjustments						0.000				
(U) C	Congressional Program Reductions										
	Congressional Rescissions										
	Congressional Increases										
r c	SPID/STTP Transfor										
	Soliciant Program Changes:										
	Significant Program Changes.										
				R-1 Line Item Page-1	n No. 29 of 5				Exhibit R-2 (PE 0603680F)	
				441							
				UNCLASS	SIFIED						

	Ex	xhibit R-2a, F	RDT&E Pro	ject Justif	ication			DATE	February	2008	
BUDGE 03 Ad	ET ACTIVITY Ivanced Technology Development	t (ATD)		P 0 T	PE NUMBER AND 1603680F Mar Technologies	TITLE		PROJECT NUME 5280 Manufa	BER AND TITLE cturing Tech	R AND TITLE auring Technologies	
	Cost (\$ in Millions)	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total	
	Exhibit R-2a, RDT&E Project Justification February VCTIVITY need Technology Development (ATD) PF NUMBER AND TITLE 0050600F Manufacturing Technologies PROJECT NUMBER AND TITLE 0050600F Manufacturing Technologies S280 Manufacturing Technologies										
5280	Manufacturing Technologies	0.000	0.000	35.756	36.432	36.779	37.488	38.244	0.000	0.000	
	Quantity of RDT&E Articles	0	0	0	0	0	0	0			
Note: . on lon	In FY 2009 the AF Manufacturing Tech g-term manufacturing technologies and	nologies program	will transfer to) PE 0603680F	, Manufacturin	g Technologies	s, from PE 070	08011F, Industri	al Preparedness	s, to focus	
The ManTech program is mandated by Section 2521, Title 10, United States Code, to create an affordable, world-class industrial base manufacturing capability responsive to the warfighter's needs. The Air Force ManTech major program tenets are: development and improvement of manufacturing technologies and processes; collaboration with government program offices, industry, and academia; investments in generic technologies that can be applied to different applications, cost-sharing; multiple system/customer applications; potential for significant return on investment; and customer commitment to implement. To this end, ManTech develops, demonstrates, and transitions advanced manufacturing processes and technologies to reduce costs, improve quality/capability, and shorten cycle times of weapon systems during design, development, production, and sustainment. Where mature processes are not available, laboratory-developed and demonstrated initial process capabilities are made available for transition into weapon system programs. ManTech objectives are conducted through partnerships with all industry levels, from large prime contractors to small material and parts vendors.								ess large			
(U) (U) (U) (U)	MAJOR THRUST: Pursue cost-effecti Air Force weapon systems. In FY 2007: Not Applicable. In FY 2008: Not Applicable. In FY 2009: Continue cost-effective rep and turbine engine components. Contin the life of critical, high value rotating en Continue assessments and manufacturin supply chain commodities. Continue ra programs.	ve maintenance, r pair and manufact nue Engine Rotor ngine components ng technology dev pid response proc	epair, and man turing technolo Life Extension , which have b elopment to re- luctivity impro	ufacturing tech gies for afforda (ERLE) spiral een in service a duce costs and vement efforts	able sustainmen II technical eff and scheduled f lead times for h with selected h	astainment of at of aircraft fort to extend for retirement. high value igh value		0.000	0.000	6.675	
(U) (U) (U)	MAJOR THRUST: Address generic an weapon systems and processes, to inclu- systems, Command and Control Intellig propulsion, stealth, and avionics/electro In FY 2007: Not Applicable.	nd critical and per- de manned and ur gence, Surveillanc pnics.	vasive affordab imanned aircra e and Reconna	ility and produ ft, advanced ta issance (C2ISF	ncibility issues f nctical missiles, R) platforms, sp	for various directed energy ace, structures,	ÿ	0.000	0.000	29.081	
Proje	ct 5280			R-1 Line Iter Page-2	n No. 29 of 5				Exhibit R-2a (I	PE 0603680F)	

		Exhibit R-	2a, RDT&E	Project Jus	stification			DATE	February	2008
BUD 03 /	GET ACTIVITY Advanced Technology Develo	pment (ATD)			PE NUMBER A 0603680F M Technologi	ND TITLE Ianufacturing es		PROJECT NUM 5280 Manuf	nologies	
(U) (U) (U)	B. Accomplishments/Planned Program (\$ in Millions) FY 2007 H In FY 2008: Not Applicable. In FY 2009: Continue high value efforts to verify advantages of flexible manufacturing, commercial/military integration, quality processing, and supplier improvements. Continue development of manufacturing capabilities for more affordable low-observable structures. Develop manufacturing capabilities for advanced propulsion technologies. Continue rapid response productivity improvement efforts for selected high value programs. Continue efforts to address critical electronics manufacturing technologies for various C2ISR and space systems in order to improve affordability and producibility. Continue efforts on Active Electronically Scanned Arrays (AESA) radar to enable improved manufacturing processes for reduced costs and cycle times and increased production throughput. Conduct assessments on critical technologies in lab and acquisition programs to ensure affordable, producible technology transition. 0.000 Total Cost 0.000									<u>FY 2009</u>
(U) (U)	acquisition programs to ensure affordable, producible technology transition. Total Cost 0.000						0.000	0.000	35.756	
(U) (U) (U)	C. Other Program Funding Sur PE 0708011F, Industrial Preparedness This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. D. Acquisition Strategy All major contracts in this Progra	mmary (\$ in Milli <u>FY 2007</u> <u>Actual</u> m Element were a	ons) <u>FY 2008</u> <u>Estimate</u> warded after full	<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>
Pro	ject 5280			R-1 Line Paç	e Item No. 29 ge-3 of 5				Exhibit R-2a ((PE 0603680F)
				UNCL	443 ASSIFIED					

		Exhibit R-2	2a, RDT&E F	Project Just	ification			DATE	February	2008
BUDG 03 Ac	ET ACTIVITY dvanced Technology Developi	ment (ATD)			PE NUMBER AN 0603680F Ma Technologies	D TITLE Inufacturing S		PROJECT NUMI 5281 Manufa	BER AND TITLE	diness
	Cost (\$ in Millions)	FY 200	07 FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	Total
	Cost (\$ III WIIIIOIIS)	Actua	1 Estimate	e Estimate	Estimate	Estimate	Estimate	Estimate	Complete	
5281	Manufacturing Readiness	0	.000 0.0	000 3.97	73 4.048	4.086	4.16	5 4.249	0.000	0.000
	Quantity of RDT&E Articles		0	0			(0 0 0 0 0		
Note:	In FY 2009 the AF Manufacturing	lechnologies pro	gram will transf	er to PE 060368	OF, Manufacturi	ng Technologie	s, from PE 07	08011F, Industri	al Preparednes	ss, to focus
	A. Mission Description and Budge Manufacturing readiness of technology production. Within each product se and manufacturing readiness levels when appropriate to aid in efficient manufacturing risk. Pervasive, gene overall program risk and to provide manufacturing issues will be identif	ogies is a key con ctor (aeronautical (MRLs) utilized t transition. Select eric and system-sp an increased awa ied and considere	cern when ident , space, munitio to gauge and man ed acquisition properties pecific manufact reness of manufact as potential M	ifying and mitig ns/directed ener, nage manufactur rograms will also uring maturation acturing issues t anTech program	ating risk to succ gy, and C2ISR), ring related issue o be assessed to o n plans will be do hroughout major as to transition ac	essfully transiti manufacturing s. Advanced T determine readi eveloped and in weapon system dvanced manufa	ion these techn readiness asse Cechnology De ness for miles aplemented ba a life cycles. C acturing technol	nologies and sys ssments (MRAs emonstrations (A tone decisions a used on the asses Generic and perv pologies into mul-	tems into) will be applie ATDs) will be und/or to reduce sments to reduce vasive tiple sectors.	ed ised e ce
an an	B. Accomplishments/Planned Program (\$ in Millions) FY 2007 FY 2008 FY									FY 2009
(U)	MAJOR THRUST: Through appli	ication of MRAs,	develop and imp	plement manufa	cturing maturatio	on plans to	<u>-</u>	0.000	0.000	3.973
	mitigate transition risk from develo	opment to produc	tion.							
(U)	In FY 2007: Not Applicable.									
(U)	In FY 2008: Not Applicable.									
(U)	In FY 2009: Develop Manufactur	MMDs will be a	ans (MMPs) for	all Category I A	I Ds and selected	d high-visibility				
	production MRAs will also be co	nducted on select	ed Air Force acc	uisition program	ns to aid in Miles	stone Decision	.0			
	Reviews and/or to mitigate cost, so	chedule, or rate is	sues. Manufactu	ring risk will be	e documented bas	sed on the				
	assessments and delivered to the a	opropriate program	m offices. Perva	sive manufactur	ring issues discov	vered during the	2			
	assessments will be vetted through	the ManTech rec	uirements proce	ss.	-	_				
(U)	Total Cost							0.000	0.000	3.973
(U)	C. Other Program Funding Sumr	nary (\$ in Millio	ns)							
	· · ·	FY 2007		FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Cost to	T 10
		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	Total Cost
(U) 1	Related Activities									
(U) 1	PE, 0708011F, Industrial									
				R-1 l ine l	tem No. 29					
Proje	ect 5281			Page	e-4 of 5				Exhibit R-2a	(PE 0603680F)
				4	44					

Exhibit R-	Exhibit R-2a, RDT&E Project Justification							
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603680F Manufacturing Technologies	PROJECT NUMBER AND TITLE 5281 Manufacturing Readiness						
 (U) <u>C. Other Program Funding Summary (\$ in Millio</u> Preparedness (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. 	<u>ons</u>)							
All major contracts in this Program Element were aw	warded after full and open competition.							
Project 5281	R-1 Line Item No. 29 Page-5 of 5	Exhibit R-2a (PE 0603680F)						

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PE NUMBER: 0603789F PE TITLE: C3I Advanced Development

	Exhib	oit R-2, RDT	&E Budge	t Item Just	ification			DATE	February	2008
BUDGET 03 Adv	r ACTIVITY vanced Technology Development (evelopment							
	Cost (\$ in Millions)	FY 2007 Actual	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	47.352	32.821	30.103	42.165	38.996	42.300	49.509	Continuing	TBD
4072	Dominant Battlespace Awareness	18.350	5.994	7.970	9.802	8.922	9.623	10.737	Continuing	TBD
4216	Battlespace Information Exchange	12.119	11.828	11.104	17.079	15.734	18.654	22.614	Continuing	TBD
4872	Aerospace Information Dominance	16.883	14.999	11.029	15.284	14.340	14.023	16.158	Continuing	TBD
(U) <u>A</u>	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 2008, Congress added \$1.0 million for Collaboration Gateway, \$0.8 million for Interoperability Network to Fuse and Exchange Real-Time Information, and \$3.9 million for Massively Parallel Optical Interconnects for Battlespace Information Exchange. This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing upgrades and/or new system developments that have military utility and address warfighter needs

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

				EXHIBIT	
		R-1 Line Item No. 30 Page-1 of 18		Exhibit F	R-2 (PE 0603789F)
	Not Applicable.				
(U)	Significant Program Changes:				
	SBIR/STTR Transfer		-1.043		
	Reprogrammings		0.200		
	Congressional Increases			5.700	
	Congressional Rescissions			-0.216	
(U)	Congressional Program Reductions			-0.020	
(U)	Total Adjustments		-0.843	5.464	
(U)	Current PBR/President's Budget		47.352	32.821	30.103
(U)	Previous President's Budget		48.195	27.357	32.050
			<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>

Exhibit R-2, RDT&	ACTIVITY PE NUMBER AND TITLE		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develop	oment	
C. Performance Metrics (U) Under Development.			
	R-1 Line Item No. 30		
	Page-2 of 18	Exhibit R-2 (PE 0603789F)	

	Exhibit R-2a, RDT&E Project Justification DATE Februa ACTIVITY anced Technology Development (ATD) PE NUMBER AND TITLE 0603789F C3I Advanced Development PROJECT NUMBER AND TIT 4072 Dominant Battles Awareness Cost (\$ in Millions) FY 2007 Actual FY 2008 Estimate FY 2010 Estimate FY 2011 Estimate FY 2012 Estimate FY 2013 Estimate Cost to Cost to Dominant Battlespace Awareness Dominant Battlespace Awareness 18.350 5.994 7.970 9.802 8.922 9.623 10.737 Continue Quantity of RDT&E Articles 0 0 0 0 0 0 0 0 Mission Description and Budget Item Justification Is project develops, integrates, and demonstrates advanced technologies to achieve Dominant Battlespace Awareness (DBA) and Predictive Battlespace Aw BA) using information from all sources. DBA is the information required to support dynamic planning and execution with the accuracy, fidelity, and timelin eded to dominate the battlespace. Technology development includes: tasking information collectors (intelligence, surveillance, and reconnaissance platform ional intelligence sources, etc.); correlating and geo-registering the collected data; exploiting the data to extract information of military significance; fusing formation from multiple sources to create a digital n-dimensional representation of the battlespace; assessing the situation; predicting adversary courses of ac OA); and archiving the results for ready use by decision makers. This is a dynamic, complex process that										
BUDG 03 Ac	ET ACTIVITY dvanced Technology Development ((ATD)		P 0	PE NUMBER AND 0603789F C31	Advanced D	evelopment	PATE February 2 PROJECT NUMBER AND TITLE 4072 Dominant Battlespace Awareness 2 FY 2013 Cost to Cost to 2 FY 2013 Cost to 2 Estimate Complete 523 10.737 Continuing 0 0 0 0 nd Predictive Battlespace Awarene: accuracy, fidelity, and timeliness e, and reconnaissance platforms, f military significance; fusing licting adversary courses of action es for information access, extraction is. FY 2007 FY 2008 2.654 1.974 9.529 4.020 9.529 4.020		e	
	Exhibit R-2a, RDT&E Project Justification DATE February 200 GET ACTIVITY Advanced Technology Development (ATD) PE NUMBER AND ITILE 0003789F C31 Advanced Development (ATZ) PROJECT NUMBER AND ITILE 0003789F C31 Advanced Development (Cot Introduce International Intelligence Awareness (PBA) using information from All sources. DBA is the information required to support dynamic planning and execution with the accuracy. Idelity, and timelines needed to dominante the buttlepsec. Technology development includes: tasking information of Intelligences surveillance, and reconnaissance platforms, national intelligence sources, etc.); correlating and geo-registering the collected data; exploiting the data to extract information of military significance; fusing information from multiple Sources to create a digital n-dimensional representation of the battlespace; assessing the situation, predicting adversary courses of action (COA); and archiving the results for randy use by decision makers. This is a dynamic, complex process that involves technologies for information access, extraction, fusion, processing, storage, and retrieval, as well as technologies for machine analysis. PY 2007 PY 2007 PY 2007 PY 2007 <th>Total</th>						Total				
4072		Actual	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Complete	770 0	
4072	Dominant Battlespace Awareness	18.350	5.994	7.970	9.802	8.922	9.623	10.737	Continuing	IBD	
		U	0	0	0	0	0	0			
) 1 1 1 (1	This project develops, integrates, and dem (PBA) using information from all sources. needed to dominate the battlespace. Techn national intelligence sources, etc.); correla nformation from multiple sources to creat (COA); and archiving the results for ready fusion, processing, storage, and retrieval, a	onstrates advand DBA is the inf nology developr ting and geo-reg e a digital n-din use by decision as well as techno	ed technologie ormation requi nent includes: distering the co nensional repre makers. This logies for mac	es to achieve D red to support tasking inform llected data; ex sentation of the is a dynamic, c hine reasoning	dynamic planni dynamic planni lation collectors xploiting the dat e battlespace; as complex proces r, pattern recogr	space Awarene ng and executions (intelligence, sea to extract information ssessing the situs s that involves nition, and time	ss (DBA) and F on with the acc surveillance, an ormation of mil justion; predictin technologies for line analysis.	Predictive Battl uracy, fidelity, nd reconnaissar litary significan ng adversary co or information a	and timeliness and timeliness ace platforms, ace; fusing purses of action access, extraction	on,	
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and demons tracking, identification, and targeting of t awareness.	(\$ in Millions) trate advanced s ime-critical targ	ignal and data ets, and inform	exploitation tec aation extractio	chnologies for on technologies	detection, for situational	<u>FY</u>	<u>2007</u> 2.654	<u>FY 2008</u> 1.974	<u>FY 2009</u> 2.152	
(U)	In FY 2007: Demonstrated a baseline cap and correlate and fuse the information wi extract information from voluminous text Geolocation capability for emerging com Initiated development of airborne-cued, g	pability to perfo th information f tual data. Initiate mercial commu- ground-based sig	rm advanced te rom other sour- ed developmen nications used nal processing	ext exploitation ces. Demonstr t of a real-time by military and	of human intel rated a prototyp Signal Process I asymmetrical	ligence reports e that is able to ing and threats.					
(U)	In FY 2008: Continue development of a commercial communications used by mil ground-based signal processing.	real-time Signal itary and asymn	Processing and netrical threats.	d Geolocation Continue dev	capability for e relopment of air	merging borne-cued,					
(U)	In FY 2009: Demonstrate a real-time sig communications used by military and asy processing. Develop multi-sensor exploit satellites. Integrate intelligence data and picture.	nal processing a mmetrical threa tation tools to er analysis produc	nd geolocation ts. Demonstra able character ts to produce as	capability for te airborne-cue ization and assenticipatory gro	emerging comit ed ground-based essment of adve und to space av	nercial l signal ersary vareness					
(U)	L										
(U)	MAJOR THRUST/CONGRESSIONAL a visualization technologies, and distributed	ADD: Develop d data fusion to	and demonstra	te advanced da effective utilization	ata handling, ev ation of the vas	ent t amounts of	1	9.529	4.020	5.818	
Proje	ct 4072			R-1 Line Iter Page-3 c	m No. 30 of 18				Exhibit R-2a (F	PE 0603789F)	
				449)						

	Exhibit R-2a, RDT&E Project Just	ification	DA	TE February	/ 2008
BUD(03 A	GET ACTIVITY Idvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develo	PROJECT NU pment 4072 Dom Awarenes	JMBER AND TITLE inant Battlespa s	ace
(U)	B. Accomplishments/Planned Program (\$ in Millions) data available to intelligence analysts to provide optimized situation awareness, as w	rell as to support all phases of	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	combat operations. Note: This errort includes \$5.8 million in FY 2007 Congression In FY 2007: Enhanced the evaluation environment for assessing the state-of-the-art transition to the warfighter. Demonstrated an automated process to visualize the over domains on a single screen and provide an optimal means of fusing all source intelling demonstration of feature-aided tracking to monitor, assess, and predict possible court development and demonstrated operator-focused dynamic resource allocation algori optimization and collaboration of information products. Initiated software and algori determination of adversarial behavior within persistent surveillance data, contextual tracking, multiple intelligence sources (multi-INT) association and cross-cueing and exploitation. Investigated methods for combining post-event processing of intellige streaming intelligence data for indications and warning functions. Conducted Congr Advanced Fusion in Urban Operations for Forensic Anticipation of Insurgent Activi Congressionally-directed effort for National Center for Multi-Source Information.	and maturity of algorithms for erlaying of disparate information gence data. Completed ses of action. Completed thms and techniques for ithmic development for tracking, target-feature-aided geospatial reasoning and cued nce data with real-time ressionally-directed effort for ty. Conducted			
(U)	In FY 2008: Continue software and algorithmic design and development efforts for behavior within persistent surveillance data, contextual tracking, target-feature-aided and cross-cueing and geospatial reasoning and cued exploitation. Continue to develop post-event processing of intelligence data with real-time streaming intelligence data functions. Initiate the design and development of a synthetic assessment environmer range of fusion technologies to include basic correlation algorithms to higher levels conjunction with command and control systems. Initiate investigation of Fusion of with traditional INTs.	determination of adversarial l tracking, multi-INT association op methods for combining for indications and warning nt for the evaluation of the full of fusion algorithms tested in Cyber Intelligence (CYBINT)			
(U)	In FY 2009: Demonstrate software and algorithmic design and development efforts behavior within persistent surveillance data, contextual tracking, target-feature-aided and cross-cueing and geospatial reasoning and cued exploitation. Demonstrate meth processing of Intel data with real time streaming Intel data for indications and warni and development of a synthetic assessment environment for the evaluation of the ful include basic correlation algorithms to higher levels of fusion algorithms tested in co Continue investigation of Fusion of CYBINT with traditional INTs. Develop the ca interest form unstructured text in order to enable automated visualization of events of	for determination of adversarial I tracking, multi-INT association ods for combining post-event ng functions. Continue design I range of fusion technologies to onjunction with C2 systems. pability to extract events of n timelines and maps.			
(U)		-			
Pro	iect 4072 R-1 Line I Page	tem No. 30 4 of 18		Exhibit R-2a	(PE 0603789F)

		Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUDGE 03 Ad	ET ACTIVITY Ivanced Technology Developi	ment (ATD)			PE NUMBER A 0603789F C	ND TITLE 3I Advanced I	Development	PROJECT NUM 4072 Domina Awareness	BER AND TITLE ant Battlespa	ce
(U) (U)	B. Accomplishments/Planned Pr MAJOR THRUST/CONGRESSIC capabilities to support multi-source management. Note: This effort cc in this thrust move to Project 4216	ogram (\$ in Mil DNAL ADD: De e capabilities, ne ontains \$1.0 milli in this PE.	lions) velop and demo w sensor types, on in FY 2007 (onstrate advanced cognitive model Congressional A	l data and inforr s, and automated dd funding. In l	nation fusion 1 fusion process FY 2008, efforts	FY	<u>7 2007</u> 4.416	<u>FY 2008</u> 0.000	<u>FY 2009</u> 0.000
(U) (U) (U)	FY 2007: Developed interoperable exploitation and data link technologies for real-time ISR management, which corporates non-traditional ISR into the management algorithms for find, fix, track, target, engage, and access. rformed a multi-platform tracking demonstration utilizing airborne assets against a variety of advanced military d asymmetric threat scenarios. Demonstrated the capability to dynamically task sensors and assure timely, ioritized transport of information for purpose of tracking high value ground targets for long durations and tentially engaging them. Conducted Congressionally-directed effort for Non-Traditional Intelligence, urveillance, and Reconnaissance. FY 2008: Not Applicable. FY 2009: Not Applicable. DNGRESSIONAL ADD: Semantic Service Oriented Architectures for Dynamic Intelligence Fusion. 1.751									
(U) (U) (U) (U)	CONGRESSIONAL ADD: Sema In FY 2007: Developed and demo sensitive knowledge across multip Intelligent Agent architectures, On In FY 2008: Not Applicable.	Intelligence Fus nd manage sense chitectures, in co mology.	sion. or context onjunction with		1.751	0.000	0.000			
(U) (U)	In FY 2009: Not Applicable. Total Cost						1	8.350	5.994	7.970
(U) <u>(</u>	C. Other Program Funding Sumr	nary (\$ in Millio FY 2007 Actual	ons) FY 2008 Estimate	FY 2009 Estimate	<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>	<u>Total Cost</u>
(U) F (U) F (U) F (U) F (U) F I	Related Activities: PE 0602702F, Command, Control, and Communications. PE 0603203F, Advanced Aerospace Sensors. PE 0603742F, Combat dentification Technology.									
Proje	ct 4072			R-1 Line Page	Item No. 30 e-5 of 18				Exhibit R-2a ((PE 0603789F)

Exhibit R-2a, RDT&E Project	Exhibit R-2a, RDT&E Project Justification					
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Development	PROJEC 4072 Do Awarer	T NUMBER AND TITLE ominant Battlespace ness			
(U) <u>C. Other Program Funding Summary (\$ in Millions)</u>						
 (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. 						
(U) D. Acquisition Strategy Not Applicable.						
R-1	Line Item No. 30		Exhibit R-22 (PE 0603780E)			
	452					

Ex	hibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
3UDGET ACTIVITY 33 Advanced Technology Development	(ATD)		P 0	E NUMBER AND 603789F C3I	Advanced De	evelopment	PROJECT NUME 4216 Battles Exchange	BER AND TITLE pace Informa	tion
Cost (\$ in Millions)	FY 2007 Actual	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
4216 Battlespace Information Exchange Ouantity of RDT&F Articles	12.119	11.828	11.104	17.079	15.734	18.654	22.614	Continuing	TBD
U) <u>A. Mission Description and Budget Iten</u> This project develops and demonstrates ad	n Justification	nications technol	ologies for the	Air Force that i	implement a sec	cure environme	ent for worldwi	de information	
coalition, and multi-national force bounda and c) provide in-transit visibility of en re States (e.g., updating information and mis advanced information management, multi mechanisms, communications transmissic information and information systems.	ries; b) support oute aircraft, carg sion changes to o -level/secure cor n systems, cyber	mobile inform go, mission stat en route aircraf nmunications, r situational aw	ation superiorit tus, and reachb t). Technology secure survival rareness, and of	ty, sensor-to-sh ack capabilities y developments ble networks, m ffensive cyber o	ooter operation s for aircraft to s include an infon nission and conto operations capal	s, and the battle operations cent ormation assura ent-based routi bilities to attack	e management ers in the Cont ince decision s ng, quality-of- c and exploit a	decision proces inental United upport system, service dversary	ss;
 B. Accomplishments/Planned Program (U) MAJOR THRUST: Develop and demon munitions, uninhabited air systems, and a (U) In FY 2007: Developed or adapted netw elements by connecting them into the air command centers. Developed phase one information sharing and collaboration wi facilities) 	(\$ in Millions) strate secure wich aircraft), ground orked communic borne network w of a small form- th other network	leband assured facilities and S cations to support reapon platform factor prototypt ting assets (airco	networking be pecial Operation ort Special Operation of and reachbac operation of the second craft, uninhabite	tween weapon ons Forces pers erations Forces ck to globally le networking cap ed air systems,	platforms (e.g. sonnel. ground ocated pability for ground	FY	<u>2007</u> 3.757	<u>FY 2008</u> 0.944	<u>FY 2009</u> 1.134
 (U) In FY 2008: Complete development of a information sharing and collaboration wi facilities). (U) In FY 2009: Develop small form-factor preparation for transition to the Special (small form-fact th other network networking and Dperations Force	or prototype in ing assets (airc reachback capa s.	formation netw craft, uninhabite ability. Begin c	vorking capabil ed air systems, certification of	lity for ground the capability ir	1			
 U) MAJOR THRUST: Proactively defend of cyber threats, and surviving through adap Applied Research PE 0602702F, Project (U) In FY 2007: Not Applicable. 	cyberspace throu otation and self-r 4519, into this F	gh cyber situat regeneration. N PE.	ional awarenes lote: This effo	s, detecting and rt transitions in	d defeating 1 FY 2008 from		0.000	0.772	2.710
			R-1 Line Iten	n No. 30					

	Exhibit R-2a, RDT&E Project Just	DATE February	/ 2008		
BUDC 03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develop	PROJECT ment 4216 Ba Exchan	NUMBER AND TITLE	ation
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2008: Develop technology demonstration plans for a fleet of cooperative ager critical Air Force assets by gathering cyber situational awareness information for def Develop secure data sharing to prevent the disclosure of sensitive information to untr	ts trusted to defend mission ensive decision making. ustworthy users.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2009: Develop technology demonstration plans for active ISR defense on wire situational awareness demonstration. Continue development of secure data sharing to sensitive information to untrustworthy users.	d networks. Continue cyber o prevent the disclosure of			
(U) (U)	MAJOR THRUST: Design, develop, demonstrate, test, and validate an integrated to Simulating the Air Force's extension of the Global Information Grid, the evolving Ai will provide the Air Force with the ability to accomplish both mission and technical a levels of fidelity, to enable the effective migration of legacy systems for the develop Airborne Network. Note: This efort transitions in FY 2008 from Applied Research I this PE.	ol suite for Modeling and rborne Network. This thrust analyses, at the appropriate nent and evolution of the PE 0602702F, Project 4519, into	0.000	0.664	1.374
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Test and validate the modeling and simulation capability using real wor accuracy and real-time nature of the capability. Establish enhancements to the curren assess processing requirements.	ld scenarios to determine the at modeling capability and to			
(0)	make it usable by an operational person instead of programmers. Exercise the limita and apply the model to proposed future DoD networking environments.	tions of the modeling capability			
(U) (U)	MAJOR THRUST: Design, develop, and demonstrate the enterprise management ca policy (e.g., word documents, or other Air Tasking Orders, etc.) and translate that for language to provide this "policy meta-data" to a network enterprise system in executa re-configure, re-constitute, and strengthen Air Force networks in response to strategie (e.g., changes in information condition (INFOCON), threat condition (THREATCON (DEFCON), malicious threat, outages, etc.). Note: This effort transitions in FY 2005	pability to accept on-paper mat into network policy able form in order to c, tactical, and network events N), defense condition 8 from Applied Research PE	0.000	0.776	1.023
(U) (U)	0602702F, Project 4519, into this PE. In FY 2007: Not Applicable. In FY 2008: Design and develop an enterprise management system with the capabili into machine-readable code in order to reconfigure the network in response to strateg	ty to translate narrative policy ic, tactical, and network threats.			
Proj	iect 4216 R-1 Line It Page-I	em No. 30 3 of 18		Exhibit R-2a	(PE 0603789F)

	Exhibit R-2a, RDT&E Project Just	TE February	/ 2008		
BUDO 03 A	GET ACTIVITY Idvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develo	PROJECT N pment 4216 Battl Exchange	JMBER AND TITLE espace Inform	ation
(U) (U)	B. Accomplishments/Planned Program (\$ in Millions) In FY 2009: Develop and demonstrate reconfiguration of network based-policy in renetwork events (e.g., changes in information condition (INFOCON), threat condition condition (DEECON) malicious threat outgoes etc.)	esponse to strategic, tactical, and n (THREATCON), defense	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop and demonstrate offensive cyber operations capabilitie cyber craft technology demonstrations. These demonstrations will integrate capabili offensive cyber programs in the areas of gaining access to systems, performing opera gathering intelligence from the compromised systems, and launching cyber "effects" effort transitions in EV 2008 from Applied Research PE 0602702E. Project 4519 int	s in a series of experimental ties developed from ongoing ations in a stealthy manner, against the systems. Note: This o this PE	0.000	1.379	2.130
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Initiate development of offensive cyber capabilities to access, remain st affect adversary information and information systems. Develop technology demonst operations.	tealthy, gather intelligence, and tration plans for cyber			
(U)	In FY 2009: Analyze development of selected offensive cyber operations capabilities operations planning and execution capabilities, and cyber command and control (Cyber Cyber	es, integrated kinetic and cyber ber C2) operations functions.			
(U) (U)	MAJOR THRUST: Develop and demonstrate advanced expert system decision algoresources for global reach. In FY 2007: Completed the transition of the combined Intelligent Information Mana	rithms to prioritize and control	0.524	0.000	0.000
(U) (U)	Controller, and the Global Media Access Controller. In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U)	MAJOR THRUST/CONGRESSIONAL ADD: Develop and demonstrate intelligent management technology to provide assured, seamless, battlespace connectivity to the reduced footprint. Note: This effort includes \$2.0 million in FY 2007 Congressional in FX 2008 Congressional Add funding	networking transport and e Air Force with a greatly l Add funding, and \$3.9 million	5.894	7.293	2.733
(U)	In FY 2007: Demonstrated improved battle management command, control, and con collaboration capabilities by making improvements in routing, mobile ad-hoc network show the effectiveness for ISR platforms. Developed and demonstrated a survivable of the global information enterprise to support rapid, decisive and sustainable air pow	nmunications networked rks, and adaptive protocols to , mobile, deployable extension wer, command and control			
Proj	ect 4216 R-1 Line li Page-	tem No. 30 9 of 18		Exhibit R-2a	(PE 0603789F)

	Exhibit R-2a, RDT&E Project Just	DATE February 2008			
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develo	PROJECT NL pment 4216 Battle Exchange	IMBER AND TITLE	ation
(U)	B. Accomplishments/Planned Program (\$ in Millions) weapons data links, and ISR assets. Conducted Congressionally-directed effort for l	Massively Parallel Optical	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Continue improvements in the battle management command, control at collaborative capability by demonstrating Air Force airborne networking, in a coalit environment, enabling aircraft to access each other's ISR airborne and ground inform development of advanced, automated, network and bandwidth management technolog process information in real-time to provide dynamic Quality of Assurance/Quality of Initiate investigation to provide assured access (anti-jam) covert high capacity spectrue networking, while denying the adversary the same. Conduct Congressionally-direct Optical Interconnects for Battle Information Exchange to expand the number of wave developments in flip-chip mounting of different lasers to a common dielectric silicon represents a significant breakthrough in optoelectronic device technology.	nd communications networked on and multi-service nation environments. Initiate the ogies to move, manage, and f Service for the warfighter. rum dominance for global ed effort for Massively Parallel elengths by utilizing FY 2007 n optical bench (SiOB). This			
(U)	In FY 2009: Complete improvements in the battle management command, control, collaborative capability by demonstrating Air Force airborne networking, in a coalit environment, enabling aircraft to access each other's intelligence, surveillance, and r ground information environments. Continue investigation to provide assured access spectrum dominance for global networking, while denying the adversary the same.	and communications networked on and multi-service econnaissance airborne and (anti-jam) covert high capacity			
(U) (U) (U)	CONGRESSIONAL ADD: Hybrid Radio Frequency - Optical Communications Ter In FY 2007: Conducted Congressionally directed effort for Hybrid Radio Frequency Terminal. Developed parts and subsystems that can be used in either optical or RF of used simultaneously for RF and optical communications. Integrated RF and Optical subsystem. Developed the signaling protocols combining optical and RF characterist concepts for the combined RF and optical techniques.	rminal. 7 - Optical Communications communications systems, and be hardware into a common tics. Developed packaging	0.975	0.000	0.000
(U) (U) (U)	In FY 2008: Not Applicable. In FY 2009: Not Applicable.				
(U) (U)	CONGRESSIONAL ADD: Cyber Security - Advanced Course in Engineering. In FY 2007: Developed training program in cyber security through the completion of areas of security policy, computer security, cryptography, steganography, digital for defense, network attack, wireless security, and next generation security.	of research topics covering the ensics, network security, network	0.969	0.000	0.000
Proj	ect 4216 R-1 Line I Page-	tem No. 30 10 of 18		Exhibit R-2a	(PE 0603789F)

	Exhibit R-	2a, RDT&E	Project Jus	tification			DATE	February	2008
BUDGET ACTIVITY 03 Advanced Technology Develop		PE NUMBER A 0603789F C	ND TITLE 3I Advanced I	Development	PROJECT NUM 4216 Battles Exchange	IBER AND TITLE	tion		
 (U) <u>B. Accomplishments/Planned Pr</u> (U) In FY 2008: Not Applicable. (U) In FY 2009: Not Applicable. 	<u>ogram (\$ in Mil</u>	<u>lions)</u>				<u>FY</u>	2007	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U) Total Cost						1	2.119	11.828	11.104
 (U) <u>C. Other Program Funding Summ</u> (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) <u>D. Acquisition Strategy</u> Not Applicable. 	mary (\$ in Millio <u>FY 2007</u> <u>Actual</u>	pns) FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	<u>Cost to</u> <u>Complete</u>	<u>Total Cost</u>
Project 4216			R-1 Line Page	Item No. 30 -11 of 18				Exhibit R-2a (PE 0603789F)
				157 ASSIFIED					

	Ext	nibit R-2a, F	RDT&E Pro	ject Justifi	ication			DATE	February	2008
BUDG 03 A	BUDGET ACTIVITY 03 Advanced Technology Development (ATD)					PE NUMBER AND TITLE PROJECT NUMBER AND T 0603789F C3I Advanced Development 4872 Aerospace Infor Dominance				
	Cost (\$ in Millions)	FY 2007 Actual	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	16.883	14.999	11.029	15.284	14.340	14.023	16.158	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0		
	In order to achieve information dominance space and cyberspace) at all levels of war (project develops and demonstrates technolo to monitor, assess, plan, and execute (MAF other than war. It will develop and demons allowing decision makers to determine the realize a strategy-to-task approach to warfa distributed information technologies that pr dynamic, scalable, globally distributed Air to support robust, real-time, large-scale Air	, the Air Force a strategic, opera- ogies necessary PE) on the comp strate a new gen desired operationer, exploiting a rovide the deciss and Space Oper Force commar	must be able to tional, and tacti for dynamic de lex and compre- eration of plan onal effects and nticipatory env ion maker and rations Center of d and control s	plan, assess, n ical) and during ecision making essed time scal ning and assess prosecute the ironments and staff with sean (AOC). This p systems.	nonitor, and rep g all phases of c . It provides the les required for sment technolo mission accord agile command nless access to to project will also	olan missions ra conflict (pre-co e technology ar tomorrow's con gies that enable lingly. This pro and control co tailored multi-r develop know	apidly across th nflict, conflict ad demonstration nflicts, whether e a new paradig oject will develop oncepts. It will nedia, multi-spe ledge-based inte	e full spectrum and stability op ons needed to en they are comba on of network e op innovative c develop and de ectral data, with elligent informa	of operations (perations). This hable the warfig at or operations enabled operation enabled operation enablities that emonstrate hin a mobile, ation technolog	(air, s ghter s ons, will gies
(U) (U)	B. Accomplishments/Planned Program MAJOR THRUST: Develop and demons reconfigurable and provide seamless acces in mobile, dynamic, scalable, globally dis In FY 2007: Investigated a core set of fur repositories for next generation operation forces and operations across security bour planning and re-planning options to enable Demonstrated highly efficient business pr centers and other command and control co physics-based modeling to provide accurated command and control decision-support ca	(\$ in Millions) trate distributed ss to tailored matributed comma nctionality and s centers, enablir ndaries in a coal e dynamic deco occesses and too enters. Prototyp tte, detailed adv pabilities. Initi	information te ulti-media, mul nd and control supporting infra- ig the ability to ition environm nfliction capab ls to support in red and demons- ice necessary to ated investigati	echnologies tha lti-spectral data centers. astructure, inclu- plan, direct, co- ent. Develope ilities; avoidin formation exch strated intellige o make informa-	at are scalable a a for decision m uding multi-lev oordinate, and c d execution of t g hazardous con hange between ent agents that u ed decisions. D esses and proce	nd akers and staff el security control air the air space nditions. operations ise Developed dures to	FY	<u>2007</u> 5.493	<u>FY 2008</u> 4.134	<u>FY 2009</u> 1.526
Proje	normalize the use of information operation adversaries within the air, space, and cybe information distribution systems and adap surveillance system for very high resolution Initiated development of polymorphic corr ect 4872	ns with precisio erspace domains otive embedded on, wide-area, a nputing technol	n munitions to b. Developed p computing tech nd global posit ogy for persiste	achieve desire eer-to-peer and nniques operati ioning system- ent surveillance R-1 Line Iten Page-12 458	d effects agains d publish/subscr ing within a per coded surveilla e systems using n No. 30 of 18	st our ribe sistent nnce images. faster			Exhibit R-2a (F	PE 0603789F)

	Exhibit R-2a, RDT&E Project Just	February	/ 2008		
BUD(03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develo	PROJECT N pment 4872 Aero Dominan	ROJECT NUMBER AND TITLE 372 Aerospace Information ominance	
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	In FY 2008: Complete development of capabilities that allow a networked enabled of coordinate Air Force assets across security boundaries in a coalition environment. D capability to accomplish dynamic air space management and de-confliction of mann focused on air control measure parsing, timely conflict identification, advanced visus collaboration. Develop a campaign of experimentation to quantitatively measure tra control concepts enabled by net centric warfare capabilities. Demonstrate command capabilities. Continue to develop the capability to normalize the use of information munitions to achieve desired effects against our adversaries within the air, space and development of peer-to-peer and publish/subscribe/query information distribution sy computing techniques operating within a persistent surveillance system for very high global positioning system-coded surveillance images. Continue the development of computing technology for persistent surveillance systems using faster processing and and power requirements for processing hardware. Continue the development and ap Security/Multiple Single Levels of Security (MLS/MSLS) middleware technologies systems to support user access/denial of information at multiple security levels.	operations center to plan, direct, evelop and demonstrate the ed and unmanned aircraft alization and seamless nsformational command and and control decision-support operations with precision cyberspace domains. Complete estems and adaptive embedded in resolution, wide-area, and polymorphic (adaptable) d greatly reduced size, weight, plication of Multi-Level for persistent surveillance			
(U)	In FY 2009: Initiate the development of capabilities to allow seamless information s awareness and understanding by the decision maker. Continue the development of an measure effectiveness of information operations in conjunction with precision munit achievement of command intent in time and location to achieve "self-synchronizatio experimentation to quantitatively measure transformational command and control co warfare capabilities. Complete the development of polymorphic (adaptable) compute surveillance systems using faster processing and greatly reduced size, weight, and polyhardware. Continue the development and application of MLS/MSLS middleware ter- surveillance systems to support user access/denial of information at multiple security	sharing for enhanced situational n initial capability to plan and ions to determine successful n." Continue campaign of oncepts enabled by net centric ting technology for persistent ower requirements for processing chnologies for persistent y levels.			
(U) (U) (U)	MAJOR THRUST: Develop and demonstrate the integration of planning tools and in agents for adaptive preplanning and decision support tools for Air Force command a In FY 2007: Demonstrated tools and technologies to revolutionize air mobility infor swiftly and effectively to global demands across all spectrums of operations from hur conflict. Demonstrated advanced reasoning techniques for mobility courses-of-action	nformation-based intelligent nd control systems. mation superiority to respond manitarian relief to a major n development. Demonstrated	3.998	1.235	0.690
Proj	ect 4872 R-1 Line I Page-	tem No. 30 13 of 18		Exhibit R-2a	(PE 0603789F)

	Exhibit R-2a, RDT&E Project Jus	tification	D	February	/ 2008
BUDC 03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develor	PROJECT N oment 4872 Aero Dominan	IUMBER AND TITLE DSPACE Informa CE	tion
(U)	B. Accomplishments/Planned Program (\$ in Millions) the use of common mobility ontology to improve automation of decision support to awareness, planning, and execution management. Developed technologies to enable Mobility Air Force (MAF), civilian shared situational awareness/synchronization to ensure mission success in a global environment. Demonstrated improved synchron Global Mobility Force participants within multiple theaters and global Civil air traff Demonstrated the capability to support collaborative command and control, includin participation of players. Developed additional automated machine-to-machine exch aircraft, MAF aircraft, their respective command and control elements, and civil AT improved information sharing and interoperability between CAF and MAF mission for improved velocity, efficiency, safety, and mission success. Developed appropri	ols for increased situational e a Combat Air Force (CAF), a chieve desired "effects," and ization among Global Strike and fic management (ATM). ng dynamic and intermittent ange capabilities between CAF 'M agencies, and demonstrated planning and execution systems ate virtual staff members to	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U)	maintain a vision of command and control processes during human absences provid In FY 2008: Complete development of improved synchronization among Global St participants within multiple theaters and global Civil ATM. Complete automated m selected information capabilities between CAF aircraft, MAF aircraft, and their resp elements. Complete multi-mission optimization capability by exploiting information advanced, multi-constraint and distributed optimization techniques, and evaluation to operations with special emphasis on increased efficiency and decreased routine wor supervisory positions. Demonstrate capability for cross-functional collaboration that awareness and understanding during mission planning and execution to allow the pl self-synchronize, ensuring a highly coordinated effort. Complete development of m technologies to revolutionize air mobility information dominance to respond swiftly spacetures of operations from humanitarian reliaf to a major conflict	ing a 24/7 coverage. rike and Global Mobility Force nachine-to-machine exchange of pective command and control in discovery and delivery, models to support mobility kload across functional and at will increase situation anning and execution teams to ext generation tools and it to global demands across all			
(U)	In FY 2009: Initiate development of capabilities to be more agile within a net centr timely option generation selection and coordination capabilities that account for und erroneous information, and supports intuitive decision making process between mar complex, dynamic problems exploiting the respective strengths of machines (process (analytical reasoning). Develop dynamic workflow and workload management cap and control constellation of resources.	ic enabled environment. Develop certainty and missing and a and machine collaborating on as lots of data) and human abilities to manage the command			
(U) (U)	MAJOR THRUST: Develop and demonstrate an effects-based approach for the new assessment techniques that enable decision makers to determine the desired operation	at generation of planning and onal effects (nth-order) at the	4.483	3.570	3.300
Proj	ect 4872 R-1 Line Page	Item No. 30 14 of 18		Exhibit R-2a	(PE 0603789F)

	Exhibit R-2a, RDT&E Project Just	DATE February	2008		
BUDG 03 A	GET ACTIVITY dvanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Developm	PROJEC ent 4872 A Domin	T NUMBER AND TITLE erospace Information ance	tion
(U)	B. Accomplishments/Planned Program (\$ in Millions)		<u>FY 2007</u>	FY 2008	<u>FY 2009</u>
(U)	In FY 2007: Developed improved technologies to support effects-based planning, et enabling the generation, tasking, and assessment of effects-based dynamic air execut improvements to support operations center personnel in assessing course of action or intent, predictive battlespace awareness tools, and the ability to reason over models of Developed technologies to capture, assess, and integrate cause-and-effect (first, second endemic to this "enemy as a system." Developed advanced information technologie timelines, while also allowing significant reductions in the number of personnel required Developed a streaming Air Tasking Order (ATO) prototype capability. Developed redemonstration in a streaming ATO environment that will enable an effects-based approximation assessment, which will allow greater visibility into whether or not desired effects are	xecution, and assessment by tion orders. Developed ptions, based upon commander's of the "enemy as a system." ond, and third order) relationships s to shorten the current execution ured in an operations center. real-time operational assessment proach to operational e being achieved.			
(U)	In FY 2008: Demonstrate concepts and technologies supporting effects-based plann by enabling the generation, tasking, and assessment of effects-based tasking. Demon operations center personnel to assess, in near-real-time, various courses of action op intent. Develop technologies to capture and assess integrated cause-and-effect (first relationships endemic to this "enemy as a system." Complete the operational concept based assessment to drive software development and experimentation to determine to capabilities to assist warfighters in conducting accurate and timely assessments. Con- techniques to continually assess status of planned actions against adversary systems effects are actually achieved. Initiate an analysis of cascading effects in real-time for Initiate research to forecast actionable futures to support a decision maker's ability to blue course of action for Rapid, Decide, Act, and Adapt (RDAA). Initiate investigat potential adversaries and events-based on indications of known evidence and project threat(s).	ing, execution, and assessment instrate technologies to allow tions based upon command , second, and third order) of and architecture for effects he ability of developed omplete the development of to determine whether predicted or diverse courses of action. o appraise and plan the "best" tion of ability to forecast ted known and/or anticipated			
(U)	In FY 2009: Demonstrate technology to meet the needs for effects-based assessmen Design, develop, and demonstrate the capabilities for continuous effects-based assess environment. Demonstrate techniques to accomplish up-to-date awareness on wheth plan is meeting the desired effects. Investigate the methods to enable a decision sup the decision maker to anticipate and shape all aspects of the future battlespace. Initi- battlespace awareness tools with the ability to reason over models of the "enemy as a cascading effects in real-time for diverse courses of action. Continue research to for	t in an operational environment. sment in a dynamic tasking her the execution of the battle port environment that enables ate development of predictive a system." Continue analysis of recast actionable futures to			
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	Exhibit R-2a, RDT&E Project Jus	February 2008			
BUD(03 A	GET ACTIVITY Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603789F C3I Advanced Develo	project N ppment 4872 Aero Dominano	UMBER AND TITLE space Informa ce	tion
(U)	B. Accomplishments/Planned Program (\$ in Millions) support a decision maker's ability to appraise and plan the "best" blue course of acti investigation of ability to forecast potential adversaries and events based on indicati projected known and/or anticipated threat(s). Initiate assured end-to-end Quality of Assurance integration to the information system enterprise during malicious and no	on for RDAA. Continue ons of known evidence and Service and Quality of n-malicious faults.	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) (U)	MAJOR THRUST: Develop and demonstrate high performance computing for size applications, and emulate older computing components. Note: This effort transition Research PE 0602702F, Project 4594, into this PE.	e, weight, and power-limited ns in FY 2008 from Applied	0.000	1.343	1.081
(U) (U)	In FY 2007: Not Applicable. In FY 2008: Develop high performance computing for size, weight, and power-lim power efficient processors to DoD users by addressing power, programmability, and demonstrate emulation of older computing components and boards, allowing re-use gaining the advantages of modern semiconductor processing technology.	ited applications. Transition d radiation issues. Develop and of existing software while			
(U)	In FY 2009: Complete development of high performance computing for size, weight applications. Support the resulting hardware and software transition to the users. In autonomic small platforms for unmanned operations. Initiate analysis of hardware and software to be readily composed.	ht, and power-limited nitiate development of reliably and system/support software that			
(U)					
(U)	MAJOR THRUST: Demonstrate how a publish, subscribe, and query information revertical and horizontal integration of Air Force command, control, communication, surveillance, and reconnaissance information systems. Develop advanced prototype (COI) infosphere that support information management requirements of various Air Demonstrate how such an infosphere can interact with and enhance the current net-	nanagement paradigm can enable computers, intelligence, es of a Community of Interest Force net-centric COI's. centric operations infrastructure.	2.909	2.917	4.432
(U)	In FY 2007: Ramped down information engineering efforts that allow existing and COI infosphere prototypes. Developed next generation COI infospheres to provide to Air Force standards, and high levels of scalability. Initiated study of tactical info information exchange across the enterprise to the tactical edge. Initiated the develo management infrastructure to federate information among COI infospheres and acro communities.	new Air Force systems to utilize real-time performance, security rmation management to enable pment of information oss distinct information based			
(U)	In FY 2008: Develop tactical and federated COI infospheres to manage information	n objects from diverse sources			
	and data environments within and across the tactical edge. Apply adaptor technolog	gy to allow existing Air Force			
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110		62			
	DATE February	2008			
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BUDGET ACTIVITY 03 Advanced Te	PROJEC ent 4872 A Domina	ROJECT NUMBER AND TITLE R72 Aerospace Information Cominance			
(U) B. Accomp systems to a decentralize global infor efforts focu decision ma assigned mi headquarter generating a generic met capability in information self-manage information Continue to semantic in	lishments/Planned Program (\$ in Millions) rapidly integrate with and utilize COI information sources, with a special ed information brokering technology to enhance systems integration of in mation enterprise adapting to infrastructure and topology constraints. Co- sing on Unit Command and Control (Unit C2) and the Installation Contro- kers with an integrated, standardized enterprise capability to control and ssions; providing the ability to collaborate and synchronize unit enterprises; and sharing information real time in the accomplishment of normal da- aircraft to support the wartime Air Tasking Order. Initiate the developmen- hodology for the dissemination of information across multiple security le- ntegrating tactical and edge user information management requirements. transformation services and adaptive information management services e, and self-heal. Initiate a study on collaboration services on demand tha services matching end user devices (laptops, cell phones, etc.) with appr support development of COI Infospheres in the areas of context aware c teroperability.	emphasis on distributed and formation sources across the omplete information engineering of Center goals of providing unit manage resources to execute se activities with the warfighting y-to-day operations or in ent of technologies that enable a evel boundaries. Develop Initiate development of that learn, self-configure, t will exploit dynamic ropriate information formats. ollaborative user interfaces and	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) In FY 2009 multiple sec convert uns edge user ir adaptive inf study on co (laptops, ce user interface)	Develop and demonstrate technologies that enable pub/sub/query infor curity level boundaries. Initiate the study of discovery and filter technoloc tructured information into structured information feeds. Demonstrate can formation management requirements. Continue development of information cormation management services that learn, self-configure, self-manage, a llaboration services on demand that will exploit dynamic information ser ll phones, etc.) with appropriate information formats. Continue to suppo ces and semantic interoperability.	mation dissemination across ogy to assess, evaluate, and pability integrating tactical and ation transformation services and nd are self-healing. Continue vices matching end user devices rt context aware collaborative			
 (U) (U) CONGRES (U) In FY 2007 (U) In FY 2008 Collaboration commercial (U) In FY 2009 (U) 	 SIONAL ADD: Collaboration Gateway. Not Applicable. Conduct Congressionally-directed effort for Collaboration Gateway to on Gateway Architecture to support cross-domain audio conferencing, w collaboration tools, and enhanced federated information search & retriet: Not Applicable. 	develop the capabilities of the hite-boarding, interoperability of val capabilities.	0.000	1.000	0.000
Project 4872	R-1 Line I Page-	tem No. 30 17 of 18		Exhibit R-2a	(PE 0603789F)

		Exhibit R-	2a, RDT&E	Project Jus	tification			Γ	February	2008		
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)						PE NUMBER AND TITLE PROJEC 0603789F C3I Advanced Development 4872 A Domin				CT NUMBER AND TITLE Aerospace Information nance		
(U) (U) (U) (U)	B. Accomplishments/Planned Pr CONGRESSIONAL ADD: Interop In FY 2007: Not Applicable. In FY 2008: Conduct Congression Information to demonstrate a threa physical security, surveillance, con environmental monitoring sites and Monument using the Integrated In In FY 2009: Not Applicable.	ogram (\$ in Mil perability Networ nally-directed effo at agent network of mmand and contr d to the command aformation Manag	lions) k to Fuse and E ort for Interoper capable of provi ol, wireless cons d center and oth gement System	Exchange Real-T ability Network ding chemical de nectivity betwee er existing techn (IIMS).	ime Information to Fuse and Exc etection, intrusion the screening sology at Liberty	n. Change Real-Tim on detection, and 7 Island National	<u>F</u> ne I	<u>Y 2007</u> 0.000	<u>FY 2008</u> 0.800	<u>FY 2009</u> 0.000		
(U)	Total Cost							16.883	14.999	11.029		
(U) (U) (U) (U)	C. Other Program Funding Summ 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>mary (\$ in Millic</u> <u>FY 2007</u> <u>Actual</u>	ns) <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>FY 20</u> <u>Estim</u>	<u>13 Cost to</u> ate Complete	<u>Total Cost</u>		
Pro	ject 4872			R-1 Line Page 2	Item No. 30 -18 of 18 164				Exhibit R-2a (PE 0603789F)		

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

	Exhibit R-2, RDT&E Budget Item Justification									DATE February 2008		
BUD 03	BUDGET ACTIVITY PE NUMBER AND TITLE 03 Advanced Technology Development (ATD) 0603924F High Energy Laser Advanced Technology Program											
	Cost (\$ in Millions)	FY 2007 Actual	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	3.596	3.790	4.013	3.890	4.026	4.364	4.329	Continuing	TBD		
509	5 High Energy Laser Advanced Technology Program	3.596	3.790	4.013	3.890	4.026	4.364	4.329	Continuing	TBD		
(U)	(U) <u>A. Mission Description and Budget Item Justification</u> This program funds high energy laser (HEL) advanced technology development through the HEL Joint Technology Office (JTO). HEL weapons have many potential advantages, including speed-of-light delivery, precision target engagement, significant magazine depth, low-cost per kill, and reduced logistics requirements. HEL weapons have the potential to perform a wide variety of military missions including interception of ballistic missiles in boost phase, defeat of high-speed, maneuvering anti-ship and anti-aircraft missiles, and the ultra-precision negation of targets in urban environments with little/no collateral damage. This program is part of an overall Department of Defense (DoD) HEL Science and Technology program. This program is in Budget Activity 3, Advanced Technology Development, since it enables and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.											
(U)	<u>B. Program Change Summary (\$ in Mi</u>	<u>llions)</u>										
(U) (U) (U) (U)	Previous President's Budget Current PBR/President's Budget Total Adjustments Congressional Program Reductions Congressional Rescissions Congressional Increases Reprogrammings SBIR/STTR Transfer <u>Significant Program Changes:</u> Not Applicable. C. Performance Metrics Under Development.						<u>FY 2007</u> 3.699 3.596 -0.103	<u>FY 7</u> 3 -0 -0	2008 .815 .790 .025	<u>FY 2009</u> 4.152 4.013		
				R-1 Line Iten Page-1	n No. 32 of 4				Exhibit R-2 (PE 0603924F)		
				465 UNCLASS	SIFIED							

Ex	hibit R-2a, F	RDT&E Pro	oject Justifi	ication			DATE	February	2008
BUDGET ACTIVITY 03 Advanced Technology Development	P 0 A	E NUMBER AND 603924F Hig dvanced Teo	TITLE h Energy Las chnology Pro	er gram	PROJECT NUMBER AND TITLE 5095 High Energy Laser Advanced Technology Program				
Cost (\$ in Millions)	FY 2007 Actual	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	3.596	3.790	4.013	3.890	4.026	4.364	4.329	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0		
This program funds high energy laser (HE advantages, including speed-of-light deliv weapons have the potential to perform a w anti-ship and anti-aircraft missiles, and the Department of Defense (DoD) HEL Scien demonstrates technologies for existing sys	EL) advanced tec ery, precision tar vide variety of m e ultra-precision ace and Technolo stem upgrades ar	hnology develor get engageme ilitary mission negation of tar gy program. T d/or new syste	opment through nt, significant n s including inte gets in urban en This program is em developmen	n the HEL Joint magazine depth erception of bal nvironments wi in Budget Acti ts that have mil	Technology O , low-cost per l listic missiles i ith little/no coll ivity 3, Advanc litary utility and	ffice (JTO). H till, and reduce n boost phase, ateral damage ed Technolog d address warf	HEL weapons h ed logistics requ defeat of high- . This program y Development ighter needs.	ave many poten nirements. HEI speed, maneuv is part of an or , since it enable	ntial L ering verall es and
 (U) <u>B. Accomplishments/Planned Program</u> (U) MAJOR THRUST: Advance solid state Technology Readiness Level 6. Develop beam-control technologies for surface an 	n (\$ in Millions) laser developme free electron las d air mission are	nt, to include a ser technologie as.	advanced technology that scale to h	ology demonstr nigh power. D	rations up to a evelop	<u>FY</u>	<u>7 2007</u> 3.596	<u>FY 2008</u> 3.790	<u>FY 2009</u> 4.013
 (U) In FY 2007: Participated in the 100 kilov requirements for other high-value experin beam control architectures and algorithm laser (FEL) demonstration. (U) In FY 2008: Continue the development of the development	watt Joint High I ments to follow t is. Developed te	Power Solid St he 100 kilowa chnologies lea	ate Laser (JHPS tt JHPSSL effo ding to a 100 ki	SSL) effort. De rt. Investigated ilowatt class fre	etermined the l advanced ee electron				
government-sponsored measurements of airborne platforms. Evaluate advanced ta	the 100 kilowatt actical laser tech	lasers. Initiat	e systems level	studies for inte	egration onto				
(U) In FY 2009: Demonstrate the two 100 ki in a joint effort to develop a high-power advanced tactical laser technologies.	ilowatt solid stat beam director su	e JHPSSL devi itable for mati	ices in laborate ng with a JHPS	ory environmen SL device. Ev	t. Participate aluate				
(U) Total Cost							3.596	3.790	4.013
Project 5095			R-1 Line Iten Page-2	n No. 32 of 4				Exhibit R-2a (PE 0603924F)
			466	; ;					

		Exhibit R-	2a, RDT&E	Project Jus	stification			D	February 2008	
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)					PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program			PROJECT NUMBER AND TITLE 5095 High Energy Laser Advanced Technology Program		
(U)	C. Other Program Funding Sum	<u>mary (\$ in Milli</u>	ons)							
		<u>FY 2007</u> Actual	<u>FY 2008</u> Estimate	<u>FY 2009</u> Estimate	<u>FY 2010</u> Estimate	<u>FY 2011</u> Estimate	<u>FY 2012</u> Estimate	<u>FY 201</u> Estima	<u>3</u> <u>Cost to</u> te Complete <u>Total Cost</u>	
(U)	PE 0602890F, High Energy Laser Research.									
(U) (U)	Surveillance System. PE 0603605F, Advanced									
(U)	Weapons Technology. PE 0601108F, High Energy									
(U)	PE 0603883C, Ballistic Missile Defense Boost Phase Segment.									
(U)	PE 0602605F, Directed Energy Technology.									
(U) (D)	Weapons Technology. PE 0602114N, Power Projection									
(U)	Applied Research. PE 0602120A, Sensors and									
(U)	Electronic Survivability. PE 0603004A, Weapons and Munitions Advanced									
(U)	Technology. PE 0602702E, Tactical Technology									
(U)	PE 0603175C, Ballistic Missile Defense Technology.									
(U)	PE 0602651M, Joint Non-Lethal Weapons Applied Research.									
(U)	PE 0603651M, Joint Non-Lethal Weapons Technology									
Pro	ject 5095			R-1 Line Paç	e Item No. 32 ge-3 of 4				Exhibit R-2a (PE 0603924F)	
					467					

Exhibit R-2a, R	DATE February 2008			
BUDGET ACTIVITY 03 Advanced Technology Development (ATD)	PE NUMBER AND TITLE 0603924F High Energy Laser Advanced Technology Program	PROJECT NUMBER AND TITLE 5095 High Energy Laser Advanced Technology Program		
 (U) <u>C. Other Program Funding Summary (\$ in Millions)</u> Development. (U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication. 				
Not Applicable.				
Project 5095	R-1 Line Item No. 32 Page-4 of 4 /68	Exhibit R-2a (PE 0603924F)		