Supporting Data FY 2008/2009 Budget Estimate – February 2007

DESCRIPTIVE SUMMARIES OF THE

RESEARCH, DEVELOPMENT, TEST AND EVALUATION
Army Appropriation, Budget Activities 1, 2, and 3

Department of the Army
Office of the Secretary of the Army (Financial Management and Comptroller)

Persuasive in Peace, Invincible in War

VOLUME I

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS
OF THE
RESEARCH, DEVELOPMENT, TEST AND
EVALUATION, ARMY
FY 2008/2009
BUDGET ESTIMATE
FEBRUARY 2007

VOLUME I
Budget Activities 1, 2 and 3

Department of the Army
Office of the Assistant Secretary of the Army (Financial Management and Comptroller)

FY 2008/2009 RDT&E, ARMY
PROGRAM ELEMENT DESCRIPTIVE SUMMARIES

INTRODUCTION AND EXPLANATION OF CONTENTS

1. General. The purpose of this document is to provide summary information concerning the Research, Development, Test and Evaluation, Army program. The Descriptive Summaries are comprised of R-2 (Army RDT&E Budget Item Justification – program element level), R-2A (Army RDT&E Budget Item Justification – project level), R-3 (Army RDT&E Cost Analysis), R-4 (Schedule Profile), R-4A (Schedule Profile Detail) and R-5 (Termination Liability Funding for MDAPs) Exhibits, which provide narrative information on all RDT&E program elements and projects for FY 2006 through FY 2009.

2. Relationship of the FY 2008/2009 Budget Submission to the FY 2007 Budget Submitted to Congress. This paragraph provides a list of program elements restructured, transitioned, or established to provide specific program identification.

A. Program Element Restructures. Explanations for these changes can be found in the narrative sections of the Program Element R-2/R-3 Exhibits.

OLD PE/PROJECT	NEW PROJECT TITLE	NEW PE/PROJECT
0604645A/F52	FCS Reconnaissance Platforms	0604662A/FC3
0604645A/F53	FCS Unmanned Ground Vehicles	0604663A/FC4
0604645A/F54	FCS Unattended Ground Sensors	0604664A/FC5
0604645A/F55	FCS System of Systems Engineering & Program Management	0604661A/FC2
0604645A/F57	FCS Manned Ground Vehicles & Common Ground Vehicle	0604660A/FC1
0604645A/F61	FCS System of Systems Engineering & Program Management	0604661A/FC2
	FCS Network Hardware & Software	0604665A/FC6
	FCS – Spin Out Technology/Capability Integration	0604666A/FC7
0203802A/781	Joint Air-to-Ground Missile (JAGM)	0603460A/JA2

B. Developmental Transitions. Explanations for these changes can be found in the narrative sections of the Program Element R-2/R-3 Exhibits.

C. Establishment of New FY 2008/2009 Program Elements/Projects. There are no major system new starts. Minor new initiatives for FY 2008/2009 are shown below.

TITLE	PE/PROJECT
Vertical Lift Research Center of Excellence	0601104A/J17
Joint Air-to-Ground Missile (JAGM)	0603460A/JA2
FCS Reconnaissance Platforms	0604662A/FC3
FCS Unmanned Ground Vehicles	0604663A/FC4
FCS Unattended Ground Sensors	0604664A/FC5
FCS System of Systems Engineering & Program Management	0604661A/FC2
FCS Manned Ground Vehicles & Common Ground Vehicle	0604660A/FC1
FCS Network Hardware & Software	0604665A/FC6
FCS – Spin Out Technology/Capability Integration	0604666A/FC7
Counter-Rocket, Artillery & Mortar (C-RAM) Development	0604741A/149

D. FY 2008/2009 programs for which funding existed in the FY 2007 President's Budget Submit (February 2006), but which are no longer funded in FY 2008/2009.

PE/PROJECT	TITLE	BRIEF EXPLANATION
0603809A/1TR	Future Transport Rotorcraft (FTR)	Program Terminated
0604802A/705	Advanced Precision Kill Weapon System (APKWS)	Program Terminated
0604827A/S57	Land Warrior	Program Terminated

3. Classification. This document contains no classified data. Classified/Special Access Programs that are submitted offline are listed below.

0203808A	0603020A
0301359A	0603322A
0602122A	0603710A/C65
0603005A/C66	0604328A
0603009A	

4. Performance Metrics. Performance metrics used in the preparation of this justification book may be found in the FY 2009/2009 Army Performance Budget Justification Book, dated March 2007.

5. Program Assessment Rating Tool (PART). In accordance with the President's Management Agenda, Budget and Performance Integration initiative, this program has been assessed using PART. Remarks regarding program performance and plans for performance improvement can be located at the Expectmore.gov website.

Department of the Army
FY 2008 RDT&E Program
FY 2008/2009 Budget Estimate
Summary

Exhibit R-1

February 2007

Summary Recap of Budget Activities	Thousands of Dollars FY 2006	FY 2007	FY 2008	FY 2009
Basic Research	364,043	365,898	305,819	315,808
Applied Research	1,183,723	1,203,823	686,237	670,883
Advanced Technology Development	1,846,927	1,263,268	735,935	714,890
Advanced Component Development and Prototypes	509,014	537,361	871,342	758,936
System Development and Demonstration	5,146,327	5,039,846	5,222,457	4,772,821
Management Support	1,359,946	1,204,309	1,140,246	1,107,873
Operational System Development	1,263,097	1,345,228	1,623,297	1,449,381
Total RDT&E, Army	11,673,077	10,959,733	10,585,333	9,790,592

			Summary Recap of Budget Activities	Thousands of Dollars FY 2006	FY 2007	FY 2008	FY 2009
			Basic Research				
1	0601101A	01	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	21,651	19,187	19,266	19,790
2	0601102A	01	DEFENSE RESEARCH SCIENCES	172,510	170,122	137,676	141,423
3	0601103A	01	UNIVERSITY RESEARCH SCIENCES (H)	73,707	80,841	64,843	66,781
4	0601104A	01	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	96,175	95,748	84,034	87,814
			Total: Basic Research	364,043	365,898	305,819	315,808
			Applied Research				
5	0602105A	02	MATERIALS TECHNOLOGY	34,423	60,102	18,614	19,029
6	0602120A	02	SENSORS AND ELECTRONIC SURVIVABILITY	49,951	48,575	39,826	41,017
7	0602122A	02	TRACTOR HIP	7,540	8,373	4,367	3,298
8	0602211A	02	AVIATION TECHNOLOGY	38,073	40,156	42,567	42,051
9	0602270A	02	EW TECHNOLOGY	28,746	30,972	16,411	16,605
10	0602303A	02	MISSILE TECHNOLOGY	75,149	77,276	53,038	48,324
11	0602307A	02	ADVANCED WEAPONS TECHNOLOGY	34,485	24,061	19,342	19,791
12	0602308A	02	ADVANCED CONCEPTS AND SIMULATION	25,848	25,001	16,654	17,131
13	0602601A	02	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	81,693	91,483	53,342	49,321
14	0602618A	02	BALLISTICS TECHNOLOGY	50,152	58,568	55,014	55,736
15	0602622A	02	CHEMICAL, SMOKE AND EQUIPMENT DEFEATING TECHNOLOGY	9,856	12,762	2,235	2,301
16	0602623A	02	JOINT SERVICE SMALL ARMS PROGRAM	6,449	6,178	7,008	7,571
17	0602624A	02	WEAPONS AND MUNITIONS TECHNOLOGY	123,684	118,331	40,469	30,663
18	0602705A	02	ELECTRONICS AND ELECTRONIC DEVICES	92,221	81,773	43,391	45,365
19	0602709A	02	NIGHT VISION TECHNOLOGY	30,464	36,203	24,391	25,662
20	0602712A	02	COUNTERMINE SYSTEMS	26,698	27,135	21,795	21,922
21	0602716A	02	HUMAN FACTORS ENGINEERING TECHNOLOGY	27,549	40,902	17,426	17,169
22	0602720A	02	ENVIRONMENTAL QUALITY TECHNOLOGY	17,570	19,605	15,809	15,223
23	0602782A	02	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	45,044	48,412	22,215	24,046
24	0602783A	02	COMPUTER AND SOFTWARE TECHNOLOGY	4,447	6,719	5,368	5,510
25	0602784A	02	MILITARY ENGINEERING TECHNOLOGY	48,789	51,278	51,120	52,118
26	0602785A	02	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	14,171	16,021	16,208	16,458
27	0602786A	02	LOGISTICS TECHNOLOGY	47,214	44,044	23,083	21,988
28	0602787A	02	MEDICAL TECHNOLOGY	263,507	229,893	76,544	72,584
			Total: Applied Research	1,183,723	1,203,823	686,237	670,883
			Advanced Technology Development				
29	0603001A	03	WARFIGHTER ADVANCED TECHNOLOGY	75,067	65,632	47,065	47,055
30	0603002A	03	MEDICAL ADVANCED TECHNOLOGY	293,791	299,017	53,274	54,863
31	0603003A	03	AVIATION ADVANCED TECHNOLOGY	100,095	96,575	53,890	57,615

Summary Recap of Budget Activities				Thousands of Dollars FY 2006	FY 2007	FY 2008	FY 2009
32	0603004A	03	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	106,558	92,054	59,389	74,072
33	0603005A	03	COMBAT VEHICLE AND AUTOMOTIVE ADVANCED TECHNOLOGY	212,115	204,383	131,436	108,554
34	0603006A	03	COMMAND, CONTROL, COMMUNICATIONS ADVANCED TECHNOLO	11,964	11,997	12,255	9,235
35	0603007A	03	MANPOWER, PERSONNEL AND TRAINING ADVANCED TECHNOLO	9,796	9,200	6,783	6,871
36	0603008A	03	ELECTRONIC WARFARE ADVANCED TECHNOLOGY	52,236	53,129	49,199	51,213
37	0603009A	03	TRACTOR HIKE	8,446	9,221	12,633	14,641
38	0603015A	03	NEXT GENERATION TRAINING & SIMULATION SYSTEMS	24,855	20,863	18,723	19,002
39	0603020A	03	TRACTOR ROSE	4,750	5,125	6,526	6,650
40	0603100A	03	IED DEFEAT TECHNOLOGY DEVELOPMENT	546,478			
41	0603103A	03	EXPLOSIVE DEMILITARIZATION TECHNOLOGY	20,459	25,640	10,349	10,632
42	0603105A	03	MILITARY HIV RESEARCH	12,839	12,897	6,998	7,162
43	0603125A	03	COMBATING TERRORISM, TECHNOLOGY DEVELOPMENT FOR	9,528	8,503	13,061	13,148
44	0603238A	03	GLOBAL SURVEILLANCE/AIR DEFENSE/PRECISION STRIKE T	5,722	12,852		
45	0603270A	03	EW TECHNOLOGY	21,564	25,280	17,419	18,864
46	0603313A	03	MISSILE AND ROCKET ADVANCED TECHNOLOGY	113,079	62,940	60,353	64,398
47	0603322A	03	TRACTOR CAGE	14,796	18,981	18,448	12,437
48	0603606A	03	LANDMINE WARFARE AND BARRIER ADVANCED TECHNOLOGY	26,915	30,218	25,315	30,935
49	0603607A	03	JOINT SERVICE SMALL ARMS PROGRAM	7,971	8,112	8,097	8,856
50	0603710A	03	NIGHT VISION ADVANCED TECHNOLOGY	91,213	75,615	35,892	40,114
51	0603728A	03	ENVIRONMENTAL QUALITY TECHNOLOGY DEMONSTRATIONS	15,306	17,098	14,982	16,449
52	0603734A	03	MILITARY ENGINEERING ADVANCED TECHNOLOGY	20,868	27,688	6,837	7,676
53	0603772A	03	ADVANCED TACTICAL COMPUTER SCIENCE AND SENSOR TECH	40,516	70,248	67,011	34,448
	Total: Advanced Technology Development			1,846,927	1,263,268	735,935	714,890
	Advanced Component Development and Prototypes						
54	0603024A	04	UNIQUE ITEM IDENTIFICATION (UID)	1,438	4,074	668	653
55	0603305A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION	78,756	88,001	14,389	14,034
56	0603308A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION (DEM/VAL)	32,188	38,740	17,421	20,065
57	0603327A	04	AIR AND MISSILE DEFENSE SYSTEMS ENGINEERING	96,877	136,890	176,142	135,260
58	0603460A	04	JOINT AIR-TO-GROUND MISSILE (JAGM)			53,500	
59	0603619A	04	LANDMINE WARFARE AND BARRIER - ADV DEV		8,346	24,737	29,423
60	0603627A	04	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ADV DEV	4,381	5,426	19,449	3,865
61	0603639A	04	TANK AND MEDIUM CALIBER AMMUNITION	8,050	2,572	44,578	45,733
62	0603653A	04	ADVANCED TANK ARMAMENT SYSTEM (ATAS)	35,360	8,569	142,486	108,709
63	0603747A	04	SOLDIER SUPPORT AND SURVIVABILITY	33,232	4,330	4,787	4,912
64	0603766A	04	TACTICAL SUPPORT DEVELOPMENT - ADV DEV (TIARA)	18,027	19,855	14,423	9,879
65	0603774A	04	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT	6,401	5,278	3,454	2,605

Summary Recap of Budget Activities				Thousands of Dollars FY 2006	FY 2007	FY 2008	FY 2009
66	0603779A	04	ENVIRONMENTAL QUALITY TECHNOLOGY DEM/VAL	34,252	24,194	6,149	5,389
67	0603782A	04	WARFIGHTER INFORMATION NETWORK-TACTICAL - DEM/VAL	91,968	121,798	222,296	278,893
68	0603790A	04	NATO RESEARCH AND DEVELOPMENT	4,548	4,891	4,959	5,074
69	0603801A	04	AVIATION - ADV DEV	5,384	9,536	6,481	7,503
70	0603804A	04	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	12,195	10,103	27,499	22,237
71	0603805A	04	COMBAT SERVICE SUPPORT CONTROL SYSTEM EVALUATION A	10,046	8,549	19,054	17,893
72	0603807A	04	MEDICAL SYSTEMS - ADV DEV	22,104	23,608	12,479	21,452
73	0603827A	04	SOLDIER SYSTEMS - ADVANCED DEVELOPMENT	11,084	11,478	18,178	14,119
74	0603850A	04	INTEGRATED BROADCAST SERVICE (JMIP/DISTP)	2,723	1,123	38,213	11,238
	Total: Advanced Component Development and Prototypes			509,014	537,361	871,342	758,936
	System Development and Demonstration						
75	0604201A	05	AIRCRAFT AVIONICS	9,898	48,554	57,786	71,880
76	0604220A	05	ARMED, DEPLOYABLE OH-58D	88,509	131,315	82,310	13,027
77	0604270A	05	EW DEVELOPMENT	33,158	45,053	55,716	39,974
78	0604280A	05	JOINT TACTICAL RADIO SYSTEM	131,681			270,560
79	0604321A	05	ALL SOURCE ANALYSIS SYSTEM	13,177	6,888	5,384	5,465
80	0604328A	05	TRACTOR CAGE	15,455	15,879	17,821	16,909
81	0604329A	05	COMMON MISSILE	24,920	24,724		
82	0604601A	05	INFANTRY SUPPORT WEAPONS	49,954	43,165	45,229	32,585
83	0604604A	05	MEDIUM TACTICAL VEHICLES	18,006	12,881	1,994	1,942
84	0604609A	05	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ENG DEV		5,239	1,347	5,639
85	0604622A	05	FAMILY OF HEAVY TACTICAL VEHICLES	20,937	13,311	1,947	2,920
86	0604633A	05	AIR TRAFFIC CONTROL	6,307	4,477	8,956	14,268
87	0604642A	05	LIGHT TACTICAL WHEELED VEHICLES	9,192	4,450	82,300	22,220
88	0604645A	05	ARMORED SYSTEMS MODERNIZATION (ASM)-ENG. DEV.	2,870,086	2,956,921		
89	0604646A	05	NON LINE OF SIGHT LAUNCH SYSTEM	216,668	320,650	253,410	199,064
90	0604647A	05	NON LINE OF SIGHT CANNON	132,223	110,998	137,802	89,189
91	0604660A	05	FCS MANNED GRD VEHICLES & COMMON GRD VEHICLE			696,333	772,458
92	0604661A	05	FCS SYSTEMS OF SYSTEMS ENGR & PROGRAM MGMT			1,589,466	1,407,410
93	0604662A	05	FCS RECONNAISSANCE (UAV) PLATFORMS			41,164	34,220
94	0604663A	05	FCS UNMANNED GROUND VEHICLES			90,667	96,666
95	0604664A	05	FCS UNATTENDED GROUND SENSORS			10,999	12,942
96	0604665A	05	FCS SUSTAINMENT & TRAINING R&D			678,781	536,387
97	0604666A	05	MODULAR BRIGADE ENHANCEMENT			64,796	32,442
98	0604710A	05	NIGHT VISION SYSTEMS - ENG DEV	27,753	41,161	44,619	28,795
99	0604713A	05	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	3,224	2,984	2,501	2,515

Summary Recap of Budget Activities				Thousands of Dollars FY 2006	FY 2007	FY 2008	FY 2009
100	0604715A	05	NON-SYSTEM TRAINING DEVICES - ENG DEV	53,859	124,068	35,992	17,493
101	0604741A	05	AIR DEFENSE COMMAND, CONTROL AND INTEL - ENG	49,264	21,516	21,513	22,552
102	0604742A	05	CONSTRUCTIVE SIMULATION SYSTEMS DEVELOPMENT	38,576	39,563	31,962	26,379
103	0604746A	05	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	2,160	8,046	18,025	23,728
104	0604760A	05	DISTRIBUTIVE INTERACTIVE SIMULATIONS (DIS) - ENGIN	28,192	20,418	16,594	16,181
105	0604780A	05	COMBINED ARMS TACTICAL TRAINER (CATT)	41,139	38,471	37,035	29,652
106	0604783A	05	JOINT NETWORK MANAGEMENT SYSTEM	4,695	5,129	2,786	679
107	0604802A	05	WEAPONS AND MUNITIONS - ENG DEV	110,817	121,427	55,368	32,344
108	0604804A	05	LOGISTICS AND ENGINEER EQUIPMENT - ENG DEV	14,790	42,330	45,009	35,971
109	0604805A	05	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ENG DEV	309,036	13,037	10,047	9,858
110	0604807A	05	MEDICAL MATERIEL/MEDICAL BIOLOGICAL DEFENSE EQUIPM	15,890	24,536	15,823	35,190
111	0604808A	05	LANDMINE WARFARE/BARRIER - ENG DEV	103,399	92,237	142,315	89,105
112	0604814A	05	ARTILLERY MUNITIONS - EMD	101,957	101,422	63,039	78,532
113	0604817A	05	COMBAT IDENTIFICATION	2,193	39	11,362	3,404
114	0604818A	05	ARMY TACTICAL COMMAND & CONTROL HARDWARE & SOFTWAR	77,381	59,901	99,202	65,082
115	0604820A	05	RADAR DEVELOPMENT	4,775	2,499	7,067	
116	0604822A	05	GENERAL FUND ENTERPRISE BUSINESS SYSTEM (GFEBS)	68,372	21,751	53,559	50,237
117	0604823A	05	FIREFINDER	43,711	54,542	77,279	31,424
118	0604827A	05	SOLDIER SYSTEMS - WARRIOR DEM/VAL	63,251	28,826		
119	0604854A	05	ARTILLERY SYSTEMS - EMD	5,222	1,632	24,221	24,073
120	0604869A	05	PATRIOT/MEADS COMBINED AGGREGATE PROGRAM (CAP)	274,339	325,945	372,146	408,182
121	0604870A	05	NUCLEAR ARMS CONTROL MONITORING SENSOR NETWORK		7,346	7,300	7,300
122	0605013A	05	INFORMATION TECHNOLOGY DEVELOPMENT	62,161	96,515	103,485	55,978
	Total: System Development and Demonstration			5,146,327	5,039,846	5,222,457	4,772,821
	Management Support						
123	0604256A	06	THREAT SIMULATOR DEVELOPMENT	27,598	23,517	21,887	21,482
124	0604258A	06	TARGET SYSTEMS DEVELOPMENT	11,446	12,785	13,499	13,570
125	0604759A	06	MAJOR T&E INVESTMENT	61,626	65,325	66,921	65,004
126	0605103A	06	RAND ARROYO CENTER	20,382	21,234	16,342	16,444
127	0605301A	06	ARMY KWAJALEIN ATOLL	156,212	176,916	182,136	166,772
128	0605326A	06	CONCEPTS EXPERIMENTATION	37,283	25,293	34,004	28,440
129	0605502A	06	SMALL BUSINESS INNOVATIVE RESEARCH	273,546			
130	0605601A	06	ARMY TEST RANGES AND FACILITIES	349,783	385,498	357,964	343,030
131	0605602A	06	ARMY TECHNICAL TEST INSTRUMENTATION AND TARGETS	54,039	80,467	74,391	75,067
132	0605604A	06	SURVIVABILITY/LETHALITY ANALYSIS	39,518	43,544	40,343	41,111
133	0605605A	06	DOD HIGH ENERGY LASER TEST FACILITY	16,940	16,438	2,801	2,840

Summary Recap of Budget Activities				Thousands of Dollars FY 2006	FY 2007	FY 2008	FY 2009
134	0605606A	06	AIRCRAFT CERTIFICATION	2,694	4,530	4,688	5,024
135	0605702A	06	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	7,810	8,477	8,346	8,313
136	0605706A	06	MATERIEL SYSTEMS ANALYSIS	15,210	16,344	16,526	16,987
137	0605709A	06	EXPLOITATION OF FOREIGN ITEMS	4,487	4,938	3,291	3,530
138	0605712A	06	SUPPORT OF OPERATIONAL TESTING	74,044	80,163	75,293	72,974
139	0605716A	06	ARMY EVALUATION CENTER	49,882	59,465	61,694	63,400
140	0605718A	06	SIMULATION & MODELING FOR ACQ, RQTS, & TNG (SMART)	3,945	5,380	5,342	5,360
141	0605801A	06	PROGRAMWIDE ACTIVITIES	52,036	71,418	73,718	73,596
142	0605803A	06	TECHNICAL INFORMATION ACTIVITIES	48,552	47,356	41,607	43,140
143	0605805A	06	MUNITIONS STANDARDIZATION, EFFECTIVENESS & SAFETY	36,413	36,914	19,606	20,992
144	0605857A	06	ENVIRONMENTAL QUALITY TECHNOLOGY MGMT SUPPORT	3,838	4,370	4,958	5,158
145	0605898A	06	MANAGEMENT HEADQUARTERS (RESEARCH AND DEVELOPMENT)	12,647	13,937	14,889	15,639
146	0909999A	06	FINANCING FOR CANCELLED ACCOUNT ADJUSTMENTS	15			
	Total: Management Support			1,359,946	1,204,309	1,140,246	1,107,873
	Operational System Development						
147	0603778A	07	MLRS PRODUCT IMPROVEMENT PROGRAM	109,955	74,672	54,055	60,003
148	0603820A	07	WEAPONS CAPABILITY MODIFICATIONS UAV	2,876	1,582	3,900	
149	0102419A	07	JOINT LAND ATTACK CRUISE MISSILES DEFENSE (JLENS)	99,851	242,781	481,251	353,983
150	0203726A	07	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	16,150	18,191	16,837	15,912
151	0203735A	07	COMBAT VEHICLE IMPROVEMENT PROGRAMS	23,737	14,380	27,615	6,020
152	0203740A	07	MANEUVER CONTROL SYSTEM	36,602	34,590	43,961	28,166
153	0203744A	07	AIRCRAFT MODIFICATIONS/PRODUCT IMPROVEMENT PROGRAM	304,408	303,491	325,643	417,911
154	0203752A	07	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	1,982	851	476	331
155	0203758A	07	DIGITIZATION	12,878	14,709	9,737	11,056
156	0203759A	07	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW (FBCB2	18,535	26,083	32,446	13,666
157	0203764A	07	TACTICAL WHEELED VEHICLE IMPROVEMENT PROGRAM	13,418			
158	0203801A	07	MISSILE/AIR DEFENSE PRODUCT IMPROVEMENT PROGRAM	15,516	10,651	30,219	38,115
159	0203802A	07	OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS	25,105	22,554	1,897	1,537
160	0203808A	07	TRACTOR CARD	6,514	7,162	16,573	19,727
161	0208010A	07	JOINT TACTICAL COMMUNICATIONS PROGRAM (TRI-TAC)	22,909	5,740	1,536	926
162	0208053A	07	JOINT TACTICAL GROUND SYSTEM	12,358	14,878	23,462	7,954
163	0208058A	07	JOINT HIGH SPEED VESSEL (JHSV)	3,126	20,172	5,148	2,955
164	0301359A	07	SPECIAL ARMY PROGRAM				
165	0301555A	07	CLASSIFIED PROGRAMS				
166	0301556A	07	SPECIAL PROGRAM				
167	0303028A	07	SECURITY AND INTELLIGENCE ACTIVITIES	7,976	8,327		

Department of the Army
FY 2008 RDT&E Program
FY 2008/2009 Budget Estimate
Summary

Exhibit R-1

February 2007

Summary Recap of Budget Activities				Thousands of Dollars FY 2006	FY 2007	FY 2008	FY 2009
168	0303140A	07	INFORMATION SYSTEMS SECURITY PROGRAM	51,831	25,466	28,332	26,720
169	0303141A	07	GLOBAL COMBAT SUPPORT SYSTEM	65,960	47,986	129,689	105,567
170	0303142A	07	SATCOM GROUND ENVIRONMENT (SPACE)	48,015	32,420	107,849	106,999
171	0303150A	07	WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM	16,122	12,065	24,836	14,112
172	0303158A	07	JOINT COMMAND AND CONTROL - ARMY	1,626	4,013	10,415	10,386
173	0305204A	07	TACTICAL UNMANNED AERIAL VEHICLES	144,801	153,227	97,947	62,836
174	0305206A	07	AIRBORNE RECONNAISSANCE ADV DEVELOPMENT	5,321	1,001		
175	0305208A	07	DISTRIBUTED COMMON GROUND/SURFACE SYSTEMS (JMIP)	92,841	134,313	81,580	73,974
176	0702239A	07	AVIONICS COMPONENT IMPROVEMENT PROGRAM	953	1,020	1,024	1,030
177	0708045A	07	END ITEM INDUSTRIAL PREPAREDNESS ACTIVITIES	101,170	112,223	66,869	69,495
178	1001018A	07	NATO JOINT STARS	561	680		
	Total: Operational system development			1,263,097	1,345,228	1,623,297	1,449,381
				11,673,077	10,959,733	10,585,333	9,790,592

Total: RDT&E, Army

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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601101A - In-House Laboratory Independent Research**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	21651	19187	19266	19790	19178	19236	19637	20047
91A	ILIR-AMC	15392	14103	14113	14636	14033	14036	14323	14616
91C	ILIR-MED R&D CMD	3632	3592	3640	3615	3661	3697	3778	3861
91D	ILIR-CORPS OF ENGR	1366	1302	1317	1335	1273	1286	1314	1343
91E	ILIR-ARI	302	190	196	204	211	217	222	227
91J	IN-HOUSE LAB INDEPENDENT RESEARCH - MEDICAL (CA)	959							

A. Mission Description and Budget Item Justification: The goal of the Army's In-House Laboratory Independent Research (ILIR) program is to attract and retain top flight science and engineering PhDs to the Army's research organizations. This basic research lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The ILIR program provides a source of competitive funds to Army laboratories to stimulate high quality, innovative research with significant opportunity for payoff in Army warfighting capability. The ILIR program serves as a catalyst for major technology breakthroughs by giving laboratory directors flexibility in implementing novel research ideas and nurturing promising young scientists and engineers. Successful ILIR projects are typically transitioned to start-up projects under basic or applied research mission funding within an organization. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DoD Basic Research Plan (BRP). The work in this program is performed by the Army Materiel Command (AMC), Army Medical Research and Materiel Command (MRMC), the Army Corps of Engineers Engineer Research, and Development Center (ERDC), and the Army Research Institute for the Behavioral and Social Sciences (ARI).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601101A - In-House Laboratory Independent Research**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	21236	19402	18416	18824
Current BES/President's Budget (FY 2008/2009)	21651	19187	19266	19790
Total Adjustments	415	-215	850	966
Congressional Program Reductions		-73		
Congressional Rescissions				
Congressional Increases				
Reprogrammings	415	-142		
SBIR/STTR Transfer				
Adjustments to Budget Years			850	966

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601101A - In-House Laboratory Independent Research**	**91A**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
91A ILIR-AMC	15392	14103	14113	14636	14033	14036	14323	14616

A. Mission Description and Budget Item Justification: This project provides funding for In-house Laboratory Independent Research (ILIR) in the Army Materiel Command's six Research, Development, and Engineering Centers (RDECs). This basic research lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The cited work is consistent with Strategic Planning Guidance, the Department of Defense (DoD) Basic Research Plan (BRP), the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. Work in this project is performed by the Army Materiel Command and the Army Research Institute.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
- Edgewood Chemical Biological Center - In FY06, expanded the biomarkers project to include proteins in multiple tissues, as well as a hair follicle assay. Explored novel genomic signatures of ricinus species, development of vibrio cholerae as a model for hyper-variable mutator strains, and multiplexed protein separation technology. The vibrio study is significant for the detection of genetically engineered pathogens. In addition, the multigenically engineered antibody lines was completed. In FY07, continuing novel approaches to develop a multifunctional biological agent simulant; investigate of methodology to identify and quantify physiological response to toxic agents, investigate advanced genetic analysis methods that might lead to facile detection and identification methods for biological material, solicitng new concepts to address standoff detection of chemical vapors and aerosols; improving decontamination effectiveness against toxic chemical and biological materials with minimal effect on the environment and materials of construction, including sensitive items such as electronics; characterizing protective materials for filters and other materials; and developing and pursuing new concepts for multi-purpose obscurant materials. In FY08 and FY09, will solicit new concepts for basic research efforts with broad applicability to point and stand-off detection and identification of chemical vapors and biological aerosols, targeted decontamination, protection, information technology, and obscuration sciences.	1612	1291	1123	1135
- Armaments RDEC - In FY06, conducted basic research in energetics, smart munitions, armament materials, directed energy, and nanomaterials applied to armaments/munitions to achieve higher lethality on target, affordable increase in munitions accuracy, and directed energy target effects. In FY07, conduct research into modeling of semi-metal energetics, new modalities for e-field sensors, classifying mortar variants using acoustic sensors, SiC/carbon nanotube composites, new nitration methods for high density high energy materials to achieve increased lethality, accuracy, survivability, and volume reduction for the armament systems/munitions. In FY08, will conduct basic research for developing new explosives and smaller warheads for increased lethality and volume reduction, lighter and stronger materials for guns, algorithms for future intelligent munitions using various sensors, and area denial technologies. In FY09, will continue to conduct basic research for developing new explosives and smaller warheads for increased lethality and volume reduction, lighter and stronger materials for guns, algorithms for future intelligent munitions using various sensors, and area denial technologies.	2706	2154	1899	1958
- Tank-automotive RDEC - In FY06 formulated evolutionary computing algorithms for adaptive path planning and navigation for improved autonomous robotic ground vehicles; developed in-situ combustion chamber temperature and pressure sensors to validate high performance engine, thermodynamic combustion models for increased military engine performance and fuel economy. In FY07, develop	1900	1433	1353	1364

reinforcement learning algorithms and compare performance with bio-inspired robot behaviors for the next generation explosive ordinance disposal (EOD) robots; compute liquid heat pipe (LHP) coefficients for innovative thermal heat transfer mechanisms in electronic equipment thermal management applications. In FY08, will investigate experimental engine exploration of JP-8 ignition behavior and flame for high performance military engine combustion; new design methodologies for thick section composites using multiple failure theories for improved light-weight material reliability, and will develop spectral fractal geometry and linear/non-linear filtering for real time dynamic simulation of Army tactical and combat vehicles. In FY09, will record real-time polarization images for robotic vehicle terrain perception and signature countermeasure applications; will investigate ultra-wide band (UWB) radar development for localizing mobile robots in battlefield scenarios, and explore fuzzy logic clustering algorithms for robotic vehicle stereovision range perception in difficult urban terrain environments.				
- Natick Soldier Center - In FY06, investigated relationship between electrical and mechanical characteristics of flexible conducting materials in researching e-textiles; confirmed essential features of mathematical representation of permeation kinetics in model foods; examined electronic conduction in novel conducting polymers for use in fibers. In FY07, establish/confirm theoretical foundation for electrical and physical effects in hybrid conductive yarns useful in robust e-textiles; use Lie Group theory and dynamical systems analysis to investigate common characteristics in problems/solutions of interest to Soldier mission to provide a mathematical framework to help in solving disparate mathematical problems; examine means for coupling biorecognition elements to polymers with potential to sense food pathogens. In FY08, will investigate novel means for controlling nanoscale characteristics through precise morphology control, with potential to impact textiles used in Soldier ensemble, flexible wall shelters, and parachutes. In FY09, utilize morphology control data results to make initial selections of methodology to verify ability to regulate nanoscale characteristics.	1387	1459	1375	1425
- Aviation and Missile RDEC Missile Efforts - In FY06, transitioned high-frequency acoustic sensor technology to the system design of the Inertial Sensor for Target Discrimination (ISTAR) missile demonstration project. Electronically Steered, Phased Array Antennas Utilizing Semi-Conductor Technology has been transitioned to the Phased Arrays for Tactical Seekers applied technology program. Demonstrated high efficiency, white light phosphor for rugged, eye-matched solid state lighting. Implemented a microstrip circuit that produces chaotic VHF oscillations, enabling technology for ultrawide band radar applications. Developed an ultra-wide bandwidth optical limiter based on transparent, metallo-dielectric, photonic band gap structures. Demonstrated an energy-time cryptographic system for secure communication. In FY07, demonstrate solid state single-photon emitter for secure quantum communications. Investigate ultra-wide band shifterless beam steering using these VHF oscillators. Fabricate transparent metal stacks using copper and ZnO, to test for ultra-wide bandwidth optical limiting. Develop a "quantum seal" protocol for quantum communication, which allows detection of eavesdroppers after message is received and complete the security analysis against eavesdropping on energy-time cryptographic system. In FY08, will explore wide bandgap semiconductor photodetectors for advanced ultraviolet seekers. Investigate ultra-wide band chaotic arrays in radar applications. Will fabricate transparent metal stacks for applications to negative refraction and sub-wavelength resolution. In FY09, will develop THz spectroscopic imager for non-destructive testing and stand-off agent detection. Will demonstrate operation of a quantum sensor, for application to sensing electric, magnetic, or microwave fields.	2623	3178	2529	2608
- Aviation and Missile RDEC Aviation Efforts - In FY06, developed tightly coupled computational fluid dynamics/computational structural dynamics(CFD/CSD) analysis methods for improved understanding of the link between fundamental 3D unsteady transonic flow physics and aeromechanics issues; developed pressure sensitive paint measurement techniques for interaction aerodynamics research; conducted experimental study on co-axial rotor aerodynamics and benchmark vortex wake flow-field measurements; and conducted experimental study of passive boundary layer flow control for rotor airfoil dynamic stall initiated by trailing edge separation. In FY07, conduct experimental work on the limitations and turbulence modeling issues for advanced airfoil design tools operating near stall; conduct experimental study on high Reynolds number 3D bluff body turbulent boundary layer active separation control for fuselage drag	2525	1414	1832	1966

reduction; conduct experimental study of passive boundary layer flow control for rotor airfoil dynamic stall initiated by leading edge shock-induced separation. In FY08, will conduct experimental aerodynamics study on adaptive shape changes (morphing) under airfoil dynamic stall conditions; will continue study on high Reynolds number 3D bluff body turbulent boundary layer active separation control with a focus on turbulence measurements; will develop and validate adjunct airfoil optimization methods for unsteady flow conditions. In FY09, will develop and demonstrate modeling and simulation (M & S) tools for performance, loads and vibratory loads correlation on an active rotor application using wind tunnel validation data; will develop improved turbulence models for rotorcraft CFD M & S tools; will assess improved M & S tools on heavy lift interaction aerodynamics validation data; and will investigate closed-loop active flow control for heavy lift tandem fuselage lateral stability.				
- Communications-Electronics RDEC - In FY06, completed analysis of ultraviolet-C band muzzle flash intensity and detection range for counter sniper applications. Performed research enabling high bandwidth, high-efficiency small antennas at lower frequencies with reduced co-site interference. Formulated and investigated new high-energy cathode materials for advanced lithium batteries. In FY07, conduct basic research in the areas of network science and security for mobile networks; investigate polymer and polymer blends with high breakdown voltage characteristics for electrochemical systems; continue analysis of new piezoelectric materials for precision resonator applications; continue to investigate thermal substrate matching for large area material interfaces for next generation of imaging sensors. In FY08, will investigate fundamental principles needed to enable efficient upgrade of distributed software; will investigate a new family of high energy electrochemical materials for advanced batteries; will investigate methods of enhancing heat and mass transfer within micro-reactors. In FY09, will identify basic principles to automatically extract knowledge from text that continuously changes its vocabulary over time; will continue to investigate the phenomenology involving large scale network behavior and implications on security and antenna design, and will investigate the behavioral phenomenology of free space sensors to determine how they respond to environmental stimuli.	2639	1885	1677	1754
- Peer reviewed proposal efforts - Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality and responsiveness in exploring in basic research new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army which will bring a constant flow of new knowledge to our laboratories. In FY08, will solicit new and continuing basic research efforts focused on fundamental questions in science that relate to U.S. Army requirements such as network science. In FY09, will continue to solicit new basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Army problems.		1000	2325	2426
Small Business Innovative Research/Small Business Technology Transfer Programs		289		
Total	15392	14103	14113	14636

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601101A - In-House Laboratory Independent Research**	**91C**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
91C ILIR-MED R&D CMD	3632	3592	3640	3615	3661	3697	3778	3861

A. Mission Description and Budget Item Justification: This project addresses medical and force protection research initiatives performed at the six U.S. Army Medical Research and Materiel Command laboratories. Research areas address countermeasures against infectious diseases, defense against environmental extremes and operational hazards to health, and mechanisms of combat trauma and innovative treatment and surgical procedures. The cited work is consistent with Strategic Planning Guidance, the DoD Basic Research Plan (BRP), the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), Aberdeen Proving Ground, MD; U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), Fort Detrick, MD; U.S. Army Institute of Environmental Medicine (USARIEM), Natick, MA; U.S. Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX; and U.S. Aeromedical Research Laboratory (USAARL), Fort Rucker, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06 used High Performance Computing to conduct "virtual" screening of compounds originally designed for antimalarial drug research to determine if any might have broader applicability to biodefense research. Used nanoparticles to increase immune response to vaccination using a mouse animal model. Applied molecular sequencing technology to determine how the chemical agent "sulfur mustard" causes injury. The results of this research will identify new ways to treat sulfur mustard human casualties. Researched the fundamental mechanisms causing characteristic "head tilting" behavior in aircrew and unexpectedly discovered that it is independent of visual stimuli; this finding could have a significant effect on the design of future helmet-mounted displays. In FY07 and future years (FY08-09), the program will continue to fund innovative in-house basic research proposals that focus on research to explore treatments and countermeasures against militarily relevant infectious diseases; defense against environmental extremes and operational hazards to health; and mechanisms of combat trauma and innovative treatment and surgical procedures.	3632	3493	3262	3250
Peer reviewed proposal efforts: Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality and responsiveness in exploring in basic research new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army which will bring a constant flow of new knowledge to our laboratories. In FY08, will solicit new and continuing basic research efforts focused on fundamental questions in science that relate to U.S. Army requirements such as network science. In FY09, will continue to solicit new basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Army problems.			378	365
Small Business Innovative Research/Small Business Technology Transfer Programs		99		
Total	3632	3592	3640	3615

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601101A - In-House Laboratory Independent Research**	**91D**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
91D ILIR-CORPS OF ENGR	1366	1302	1317	1335	1273	1286	1314	1343

A. Mission Description and Budget Item Justification: The objective of this basic research project is to support In-House Laboratory Independent Research (ILIR) in the areas of battlespace environments, military engineering, and environmental quality/installations. Past and current ILIR efforts have had, and are having, significant impacts on technology development efforts supporting the Army transformation to the Future Force. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Battlespace Environment/Military Engineering/Environmental Quality and Installations: In FY06, investigated radar signal reflectance to remotely map soil moisture and strength for mobility and landing site assessments for aircraft. Investigated innovative acoustic processing methods that allow Soldiers to locate targets in urban areas. In FY07, investigate environmentally responsive hydrogels for innovative applications in environmental monitoring, engineering, and nanomaterials synthesis. Study and validate a discrete element model for simulating the mechanical properties of dry soil. In FY08, will investigate nanoparticle and molecular dynamics for chemical and biological networked sensing and will assess infrasound ability to characterize infrastructure. In FY09, will research factors influencing partitioning and ecological risk of military unique nanomaterials in the environment.	1366	1276	1173	1193
Peer reviewed proposal efforts: Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality and responsiveness in exploring in basic research new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army which will bring a constant flow of new knowledge to our laboratories. In FY08, will solicit new and continuing basic research efforts focused on fundamental questions in science that relate to U.S. Army requirements such as network science. In FY09, will continue to solicit new basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Army problems.			144	142
Small Business Innovative Research/Small Business Technology Transfer Programs		26		
Total	1366	1302	1317	1335

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	172510	170122	137676	141423	141597	142349	145609	149014
305	ATR RESEARCH	1172	1202	2251	2305	2353	2363	2393	2424
31B	INFRARED OPTICS RSCH	2248	2105	2441	2541	2585	2589	2632	2670
52C	MAPPING & REMOTE SENS	2287	2156	2641	2691	2720	2741	2801	2863
53A	BATTLEFIELD ENV & SIG	2707	2561	2835	2987	3018	3022	3059	3122
74A	HUMAN ENGINEERING	2669	2525	2961	3020	3052	3071	3144	3213
74F	PERS PERF & TRAINING	2475	3338	3481	3505	3534	3557	3613	3671
F20	ADV PROPULSION RSCH	1996	1935	2198	2253	2252	2260	2290	2342
F22	RSCH IN VEH MOBILITY	468	484	545	556	561	566	578	591
H42	MATERIALS & MECHANICS	1983	2020	2198	2253	2309	2362	2408	2472
H43	RESEARCH IN BALLISTICS	6536	5775	6142	6130	6187	6223	6364	6509
H44	ADV SENSORS RESEARCH	3708	3516	4023	4185	4281	4313	4363	4505
H45	AIR MOBILITY	1959	1836	2295	2342	2366	2385	2437	2491
H47	APPLIED PHYSICS RSCH	2603	2453	2807	2873	2906	2930	2971	3063
H48	BATTLESPACE INFO & COMM RSC	5366	6158	6720	6870	6999	7038	7123	7261
H52	EQUIP FOR THE SOLDIER	1030	1049	942	958	971	994	1013	1041
H57	SCI PROB W/ MIL APPLIC	58285	59295	56840	58406	59416	59477	61104	62566
H66	ADV STRUCTURES RSCH	1485	1513	1619	1659	1700	1740	1773	1820
H67	ENVIRONMENTAL RESEARCH	772	740	816	904	915	921	941	962
H68	PROC POLLUT ABMT TECH	352	363	416	424	428	432	442	451
S04	MIL POLLUTANT/HLTH HAZ	591	611	693	709	716	721	737	753
S13	SCI BS/MED RSH INF DIS	9345	8518	10497	10889	10247	10313	10540	10772
S14	SCI BS/CBT CAS CARE RS	3996	3687	4517	4692	3990	4007	4097	4185
S15	SCI BS/ARMY OP MED RSH	5623	5773	6318	6525	6246	6336	6524	6716
S19	T-MED/SOLDIER STATUS	626	608	719	752	717	731	747	764
T14	BASIC RESEARCH INITIATIVES - AMC (CA)	36805	34070						

T22	SOIL & ROCK MECH	1889	1787	2171	2213	2236	2252	2302	2352
T23	BASIC RES MIL CONST	1532	1440	1649	1713	1753	1815	1876	1948
T24	SNOW/ICE & FROZEN SOIL	1273	1150	1422	1443	1460	1471	1503	1536
T25	ENVIRONMENTAL RES-COE	4259	4531	5519	5625	5679	5719	5834	5951
T60	BRAIN IMAGING RESEARCH	1199							
T61	Basic Research Initiatives - MRMC (CA)	5271	6923						

A. Mission Description and Budget Item Justification: This program element fosters fundamental scientific knowledge and contributes to the sustainment of US Army scientific and technological superiority in land warfighting capability, provides new concepts and technologies for the Army's Future Force, and provides the means to exploit scientific breakthroughs and avoid technological surprises. It fosters innovation in Army niche areas (such as lightweight armor, energetic materials, night vision) and where the commercial incentive to invest is lacking due to limited markets (e.g., vaccines for tropical diseases). It also focuses university single investigators on research areas of Army interest, such as high-density compact power and novel sensor phenomenologies. The in-house portion of the program capitalizes on the Army's scientific talent and specialized facilities to expeditiously transition knowledge and technology into the appropriate developmental activities. The extramural program leverages the research efforts of other government agencies, academia, and industry. This translates to a coherent, well-integrated program which is executed by four primary contributors: 1) the Army Research, Development, and Engineering Command (RDECOM); 2) the US Army Engineer Research and Development Center (ERDC); 3) the Army Medical Research and Materiel Command (MRMC) laboratories; and 4) the Army Research Institute for Behavioral and Social Sciences (ARI). The basic research program is coordinated with the other Services via Defense Science and Technology Reliance (Defense Basic Research Advisory Group), and other inter-service working groups. This program responds to the scientific and technological requirements of the Department of Defense Basic Research Plan by enabling technologies that can significantly improve joint war fighting capabilities. The projects in this program element (PE)involve basic research efforts directed toward providing fundamental knowledge that will contribute to the solution of military problems related to long-term national security needs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this PE is managed by: the US Army Research Laboratory (ARL); the US Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC); the US Army Natick Soldier Center (NSC), the Medical Research and Materiel Command (MRMC), the US Army Engineer Research and Development Center (ERDC), and the US Army Research Institute for the Behavioral and Social Sciences (ARI).

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	173533	137568	141819	143742
Current BES/President's Budget (FY 2008/2009)	172510	170122	137676	141423
Total Adjustments	-1023	32554	-4143	-2319
Congressional Program Reductions		-7650		
Congressional Rescissions				
Congressional Increases		41450		
Reprogrammings	-1023	-1246		
SBIR/STTR Transfer				
Adjustments to Budget Years			-4143	-2319

Twenty-three FY07 congressional adds totaling $39728 were added to this PE.

($2493) Advanced Carbon Nanotechnology Program
($3835) Advanced Research and Technology Initiative (ARTI)
($4793) PASIS (Perpetually Assailable and Secure Info Sys)
($1917) Optical Technologies Research
($2875) Functionally Integrated Reactive Surfaces Tech
($1534) Technology Commercialization and Mgmt Network
($3835) Cyber TA
($958) Document Exploitation Technology Upgrade
($1246) Terrain Processes Res to Optimize Battlefield OPS
($958) Biological Raman and Optical Imaging Program
($958) Army Landscape Dynamics Support Program
($958) Chemical Mechanical Planarization
($958) Flexible Electronics Tesearch Initiative
($958) Fuel Logistics Reduction Through Enhanced Eng Perf
($1869) Illicit Narcotics Lab Detection System
($958) Integrated Nanosensor Tech for NBC Detection Apps
($958) Nanomaterials for ISR
($958) Organic Semiconductor Modeling & Simulation Resch
($1438) Plasti-Bone Artificial Bone Graft Development
($958) Broad Spect Anti-Viral Host Oriented Therapeutics
($2492) Combat Mental Health Initiative

($863) Imaging Research Center for Research of Disorders
($958) Viral Biosensors

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**305**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
305 ATR RESEARCH	1172	1202	2251	2305	2353	2363	2393	2424

A. Mission Description and Budget Item Justification: Automatic Target Recognition (ATR) Research seeks to enhance the effectiveness of Army systems through application of ATR technology while simultaneously reducing the workload on the Soldier. This project focuses on the fundamental underpinnings of aided and unaided target detection and identification techniques for land warfare scenarios including Tagging, Tracking, and Locating (TTL) of non-traditional targets. It is increasingly desirable to have Army systems that can act independently of the human operator to detect and track targets including clandestine tracking of non-cooperative targets. Such capabilities are needed for smart munitions, unattended ground sensors, and as replacements for existing systems, such as land mines. Critical technology issues include low depression angle, relatively short range, and highly competing clutter backgrounds. Electro-optic/infrared imaging systems that use advanced algorithms for compressing data, and detecting and identifying targets over extended battlefield conditions are needed for the Future Force. The resulting research will provide fundamental capability to predict, explain, and characterize target and background signature content, and reduce the workload on the analyst. This research is aimed at evaluating the complexity and variability of target and clutter signatures and ultimately utilizing that knowledge to conceptualize and design advanced ATR paradigms to enhance robustness and effectiveness of land warfare systems. ATR research strategies include emerging sensor modalities such as spectral and multi-sensor imaging. This research supports several technology efforts including multi-domain smart sensors, third generation forward looking infrared (FLIR), and advanced multi-function laser radar (LADAR). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Investigate new algorithms to improve unaided target detection and identification. In FY06, devised false alarm reduction and tracking algorithms for FLIR video, and conducted researched on the performance of new algorithm concepts and nonlinear methods, such as kernel methods, which were determined to improve performance and the reduction of false alarms. In FY07, investigate motion and change detection algorithms that exploit the benefits of color and FLIR video fusion, study new methods of fusing visible, near-IR, and IR imagery to improve target detection and classification. In FY08, will explore advanced methods for aided tracking via fusion of video modalities and detection likelihoods; investigate statistical algorithms for application in hyperspectral imagery; evaluate methods to classify tracked objects in color and FLIR video; and investigate novel nonlinear fusion methods for anomaly detection using hyperspectral and synthetic aperture radar (SAR). In FY09, will research novel behavior characterization algorithms for color and FLIR video; will research methods to develop ATR algorithms that exploit the fusion of disparate spatial views of a target for unattended ground sensor (UGS) network applications; and design advanced nonlinear band selection methods and implement new hyperspectral algorithms based on the selected bands.	1172	1193	1251	1305
Conduct basic research to support advances in state-of-the-art clandestine Targeting, Tracking, and Locating (TTL) for non-traditional hostile force and non-cooperative targets. Specific technical objectives, products, and deliverables are classified and in accordance with the Hostile Forces TTL Capabilities Development Document (HFTTL CDD) and the TTL Science and Technology Roadmap. This effort will directly support ARL's efforts in applied research and CERDEC's advanced research in clandestine TTL. It will be synchronized with the Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance, also beginning in FY08. In FY08,			1000	1000

technologies to be investigated and researched will be extremely wide ranging and may include but are not limited to microtechnology, Micro Electro Mechanical System (MEMS), nanotechnology, quantum dot technology, aptamer based sensors, nanomicroencapsulation of taggants, hyperspectral imaging algorithms, biomimetics, and carbon nanotubes. Technologies that have potential to achieve the goals of clandestive TTL will be identified and research to mature these areas will be conducted. In FY09 technologies selected for further exploration will begin to be matured. This will include both device and algorithm development. Technologies that are of sufficient technology readiness will transition to applied research.				
Small Business Innovative Research/Small Business Technology Transfer Programs		9		
Total	1172	1202	2251	2305

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**31B**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
31B INFRARED OPTICS RSCH	2248	2105	2441	2541	2585	2589	2632	2670

A. Mission Description and Budget Item Justification: This project supports Army research in materials and devices for active and passive infrared (IR) imaging systems. This research aims to generate new technologies for unprecedented battlefield situational awareness and to continue the dominance of Army units during night operations. To achieve these objectives for the Future Force, IR Focal Plane Arrays (FPAs), and interband cascade lasers (ICLs) with significantly improved performance, lower cost, and increased operating temperatures. This research has direct application to Army ground vehicles, aviation platforms, weapon systems, and the individual Soldier. Research is focused on material growth, detector and laser design, and processing for large area multicolor IR FPAs and interband cascade lasers. The principal efforts are directed towards novel materials for detectors and lasers, and investigating energy band-gap structures in semi-conductor materials to enhance the performance of lasers and IR FPAs. IR modeling and nanofabrication techniques are applied to the design and fabrication of IR photonic-crystal waveguide structures having customized IR properties. Micro Electro Mechanical System (MEMS) configurations are incorporated into the photonic-crystal waveguide structures to enable reconfigurable IR waveguide properties. Customized IR photonic materials and components are applied to the control of microwaves. The technical barriers in the research program include control of defects in the raw, unprocessed materials, maintaining quality control in the fabrication of the devices and arrays, limiting introduction of impurities in the material, surface passivation of the devices so that they are resistant to degradation over time and thermal management, particularly as it applies to interband cascade lasers. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Defense Basic Research Plan (DBRP). Work is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
The objective of this project is to support Army research in materials and devices for active and passive IR imaging systems to increase situational awareness in open and complex terrain; improve target detection, identification, and discrimination; and enhance IR countermeasure (IRCM) protection against missile threats. In FY06, researched IR laser materials and devised new laser devices that resulted in higher operating temperatures and output powers for increased protection against thermally guided missiles. Characterized the radiometric properties of large format medium-wave IR (MWIR) FPAs made of Type II superlattice and high efficiency Quantum Well Infrared Photodetectors (QWIPs). Designed, grew, and evaluated Long Wave IR (LWIR) Type II superlattice detectors. Fabricated large format LWIR Mercury Cadmium Telluride (MCT) detectors on silicon substrates. Researched wavelength beam-combined IR lasers for IRCM systems. Designed high operating temperature IR detectors out of MCT and III-V semiconductor material. Fabricated MEMS activated IR waveguide on semiconductor Photonic Crystal structures. In FY07, investigate high power IR lasers for IRCM and chem/bio sensing applications, research dynamic IR photonic-crystal waveguides for control of Radio Frequency signals, and evaluate dry etching and surface passivation procedures for LWIR Type II FPAs. In FY08, will investigate high-power IR lasers for free space (ground-to-satellite and satellite-to-ground) communications, design 2-color MWIR/LWIR detector structures, and research nano-scale photonic crystal waveguide device that can reconfigure by a MEMS feature. In FY09, will research frequency modulated IR lasers for covert communication applications, fabricate high operating temperature 2-color MWIR/LWIR Type II FPAs, and design and research chip-scale integrated IR-photonic circuit based on the reconfigurable photonic crystal-MEMS waveguide devices for microwave radar application.	2248	2099	2441	2541
Small Business Innovative Research/Small Business Technology Transfer Programs		6		

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**52C**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
52C MAPPING & REMOTE SENS	2287	2156	2641	2691	2720	2741	2801	2863

A. Mission Description and Budget Item Justification: The objective of this basic research project is to increase knowledge of the terrain with a focus on improving the generation, management, analysis/reasoning, and modeling of geospatial data, and the exploitation of multi-sensor data. This fundamental knowledge forms the scientific "springboard" for the future development of applications, techniques, and tools to improve the tactical commander's knowledge of the battlefield. Results of this research are used to extract and characterize natural and man-made features from reconnaissance imagery in near-real time; to exploit terrain analysis and reasoning techniques; and to explore the potential of space technology and tactical geospatial sensor technology to provide real-time terrain intelligence, command and control, and targeting support. This research exploits terrain and environmental data to improve situational awareness and enhance information dominance, leading to increased survivability, lethality, and mobility capabilities for the Future Force. The research provides the theoretical underpinnings for program element (PE) 0602784A (Military Engineering Technology) project 855, Mapping and Remote Sensing. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Sensor Phenomenology: In FY06, researched capability of new micro and nano sensors to characterize battlespace environment features. Experimented with fluorophore-based detection of chemical and biological hazards under various environmental conditions. Investigated techniques for designing maneuver decision tools that incorporated dynamic battlefield variables and evaluated knowledge-discovery concepts that carefully considered both time and geographic space as critical model components. In FY07, research exploitation of multiple types of sensors to characterize critical battlespace environment features. Experiment with mimicking biological sensory functions to characterize the battlespace environment. Investigate numerous factors believed to influence human behavior in an effort to better understand cause and effect within the battlespace. Similarly, increased understanding between cause and effect will assist in tool development, future experimentation, and simulations of spatial-temporal knowledge discovery models. In FY08, will investigate innovative approaches to hyperspectral sensing of labeled targets by third-party illumination, as well as research fluorescent nanowire arrays and molecular prisms as tunable chemical/biological/radiological sensors. In FY09, will research social network concepts to better assess important interaction within and between our adversaries, directly relating events and actions to time and geographic space. Will mature research on innovative sensing science, focusing on micro-nano sensors and multi-sensory approaches to identifying specific target phenomenology.	2287	2132	2641	2691
Small Business Innovative Research/Small Business Technology Transfer Programs		24		
Total	2287	2156	2641	2691

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**53A**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
53A BATTLEFIELD ENV & SIG	2707	2561	2835	2987	3018	3022	3059	3122

A. Mission Description and Budget Item Justification: This project provides an in-depth understanding of the complex atmospheric boundary layer associated with high-resolution meteorology, the transport, dispersion, optical properties, and characterization of chemical and biological aerosols, and the propagation of full-spectrum electro-magnetic and acoustic energy. The Future Force will operate in very complex environments (e.g. urban) and disparate terrain requiring new approaches to understanding, characterizing, and depicting micro-scale atmospheric phenomena. The lack of a complete understanding of the meteorological aspects of the complex micro-scale boundary layer in which the Army operates continues to impact our abilities to provide accurate and timely tactical weather intelligence to battlefield commanders. This project focuses on boundary layer meteorology over land and urban terrain. It supports the Army's transformation to the Future Force through formulation of future capabilities and techniques in such areas as the characterization and identification of bio-warfare agents, enhanced acoustic, and electro-optic propagation modeling techniques for improved target detection and acquisition, and formulation of objective analysis tools that can assimilate on-scene weather observations and fuse this information with forecasts to provide immediate nowcast products. These capabilities will have a direct impact on ensuring Soldier survivability, weapon system lethality, and the mobility required for future combat operations. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Research in optical and acoustical propagation in the atmosphere for enhanced Intelligence, Surveillance and Reconnaissance capabilities for the Future Force to support situational understanding and rapid targeting. In FY06, investigated capabilities for acoustic array tomography to be used for retrieving meteorological profiles. Improved optical technologies and processes used to enhance aerosol characterization and bio-hazard identification through laboratory investigation. Investigated effects of atmosphere on active imaging Short Wavelength Infra Red (SWIR) systems through a NATO characterization experiment that identified imaging system improvements. In FY07, simulate atmospheric effects on aerial mounted acoustic arrays to enhance urban acoustic propagation methodologies to improve model performance. Evaluate results of SWIR system field experiments against model for SWIR performance under a range of optical turbulence conditions to improve system designs. In FY08, will measure Two-Dimensional Angular Optical Scattering (TAOS) of atmospheric particles using improved instrumentation designed to improve detection and identification of chem/bio hazards. Implement an inversion technique to extract the optical constants of the spherical atmospheric aerosol particles to enhance capabilities for discrimination/identification of chem/bio hazards. Investigate effects of single urban structure on sound fields to enhance detection and avoidance capabilities. Implement model for propagation through atmospheric water vapor fluctuations at TeraHertz frequencies to improve sensor accuracy. In FY09, will devise and employ a model for radiative transfer effects of clouds on night vision illumination to improve visibility, investigate techniques for classification of non-spherical aerosol particles for improved chem/bio aerosol identification, and investigate effects of multiple urban structures on sound fields to enhance detection avoidance.	1652	1609	1769	1863
Increase survivability of the Future Force and improve situational awareness through research to improve the accuracy of high-resolution meteorology focused on urban and complex terrain in order to account for the natural atmospheric and battle-induced variability. In FY06, formulated new methods for use of improved near real-time three-dimensional environmental models to provide critical input to	1055	952	1066	1124

urban transport and dispersion models, including applications for wake and canopy flow parameterizations. In FY07, investigate critical stable boundary layer phenomena in complex terrain for improved understanding of boundary layer characteristics as they apply to an urban environment; investigate and evaluate the use of coupled modeling capabilities to investigate methods for identifying plume source location that will improve plume tracking; and simulate co-located Doppler radar and Doppler lidar to evaluate the ability to improve wind and cloud detection for enhanced capabilities of transport and dispersion models for chem/bio hazards. In FY08, will explore the fine-scale structure within the urban boundary layer for input to models depicting transport of chemical/biological and other dispersants. Will investigate the vertical flux effects of water vapor in the boundary layer to determine their effects on near-millimeter wavelengths sensor atmospheric propagation models. In FY09, will investigate atmospheric modeling technology for very fine-scale flows to improve local area forecast timeliness and accuracy. Will investigate water vapor fluctuation spectra as influenced by the urban boundary layer for propagation effects in complex terrain that affects sensor performance and imaging capabilities.				
Total	2707	2561	2835	2987

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**74A**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
74A HUMAN ENGINEERING	2669	2525	2961	3020	3052	3071	3144	3213

A. Mission Description and Budget Item Justification: This project focuses on improving Soldier-system performance in Future Force environments. Research is on key underlying Soldier performance phenomena such as judgment under uncertainty; echo-location and distance-estimation under degraded conditions; extending and protecting auditory and cognitive performance; human performance in automated, mixed-initiative (human control-machine control) environments; associated neurological dynamics; communications in hearing-degraded conditions; collaborative (team) and independent multi-task, multi-modal, multi-echelon Soldier-system performance, all cast against the influx of emerging Transformation-driven technological solutions and opportunities. Technical barriers include lack of methods for describing, measuring, and managing the interplay of these relatively novel phenomena in the consequent task due to situational complexity and ambiguity that characterize operations in the Future Force. Accordingly, technical solutions are being pursued in the areas of data generation and algorithm development in these emerging environments in order to update and improve our understanding of performance boundaries and requirements. These solutions include multi-disciplinary partnerships, metrics, simulation capabilities, and modeling tools for characterizing Soldier-system performance, and provide a shared conceptual and operational framework for militarily relevant research on cognitive and perceptual processes. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Research to improve Soldier auditory performance. In FY06, formulated and tested an algorithm to estimate the location of sound sources in outdoor environments. Evaluated Soldier's ability to use information carried by sound reflections from various walls (e.g., brick, glass, wood) for improved spatial orientation in urban environments In FY07, explore applications of localization algorithms to maximize audibility of unidentified sound sources; compare noise attenuation provided by the new Improved Combat Arms Earplug (ICAE) with that of the current Combat Arms Earplug (CAE); determine the effects of ICAE on Soldier auditory performance (e.g., localization, speech intelligibility, acoustic signature detection) in the presence of both continuous and impulse noise. In FY08, will determine feasibility and limitations of ultrasonic hearing. Will explore the effect of sound duration on auditory localization accuracy. In FY09, will investigate synergy between bone conduction and tactile communication for military applications. Will formulate an algorithm for predicting localization error due to headgear.	1474	1433	1247	1181
Research to assess, predict, and improve Soldier performance. In FY06, expanded capabilities for the prediction and maturation of cognitive readiness through assessment of neuro-cognitive functioning and time constraints under conditions of uncertainty. In FY07, explore integrated use of real-time neuro-physiological and other objective measures and models to manage Soldier situational overload in dynamic battlefield environments. In FY08, will investigate temporal cognition via dynamic Soldier task performance, cognitive modeling, and neuro-physiological evidence. In FY09, will identify differences in task performance as a function of individual versus team cognition. Will investigate prediction of team decision making using cognitive models.	1195	1092	1714	1839
Total	2669	2525	2961	3020

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**74F**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
74F PERS PERF & TRAINING	2475	3338	3481	3505	3534	3557	3613	3671

A. Mission Description and Budget Item Justification: This project funds behavioral and social science basic research in areas with high potential to improve personnel selection, training, leader development, human performance, and network science. Research covers areas such as assessment of practical intelligence as an aptitude that can be measured across job domains; identifying principles and potential methods for training and sustaining complex tasks arising from digital, semi-automated, and robotic systems requirements; identifying potential methods for faster learning, improved skill retention, and adaptable transfer of training to new tasks; identifying likely methods for developing leader adaptability and flexibility and for speeding the maturation process; discovering and testing the basic cognitive principles that underlie effective leader-team performance; understanding the role of emotions in regulating behavior; and improving the match between Soldier skills and their jobs to optimize performance. Research is focused on fundamental issues that are likely to improve the Army's capability to: (1) select, classify, train, and/or develop Soldiers and leaders who are adaptable in novel missions and operational environments, can function effectively in digital, information rich, and semi-autonomous environments, can effectively collaborate in quickly formed groups and when distributed in high stress environments, and possess interpersonal and intercultural skills/attributes relevant to joint-service and multi-national operations; (2) accelerate the training of leadership, interpersonal, and emotional skills that traditionally develop over long periods of time and through direct experience; and (3) support the Army's new Network Science initiative by focusing on the human cognitive and social domains - understanding individual, unit, and organizational behavior within the context of complex networked environments that will be essential for synergy between technology and human performance. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). This project is managed by the US Army Research Institute for the Behavioral and Social Sciences (ARI). Research in this project is related to and fully coordinated with efforts funded in program element (PE) 62785 project 790.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, continued developing models of basic human emotions using genetic algorithms; validated tests for measuring mental flexibility; continued work to identify optimizing training principles to achieve efficiency, durability, and flexibility in complex task environments; determined the influence of seductive detail on technology-delivered instruction; determined the effects of discrete positive and negative emotions on organizational citizenship behaviors (individual interpersonal and work behaviors that are beneficial to the organization, are discretionary, and have an important impact on the effectiveness, efficiency, and productivity of work teams and organizations); identified moderators of emotion-behavior linkages; and provided insight into how leader behaviors affect emotion-behavior linkages. In FY07, examine the human dimensions for optimizing training and performance for complex tasks; investigate methods for accelerating leader development; and identify and model the development and relationships among the psychological, demographic, and motivational factors that influence recruit enlistment, Soldier retention, productivity, and organizational citizenship. In FY08, will develop methods to identify individuals most susceptible to information biases in complex environments and methods to assess motivation for leadership self-development. Will also identify and measure individual-difference variables that predict organizational citizenship and adaptive performance. In FY09, will identify and measure individual attributes and learning principles that foster adaptive performance and promote rapid adaptability skill acquisition. Will also develop a new, culture free measure of self-control that will allow prediction of achievement above and beyond cognitive ability.	2475	2298	2481	2505
In FY07, as part of the Army's new initiative in Network Science, will begin research on human networks with a focus on cognitive and		955	1000	1000

social domains (research focused on individual, unit, and organizational behavior in context of networked environments). In FY08, will conduct research on human use of networks, communication, and command and control technologies to include automated agents, distributed environments, and improved, integrated assessment. Will create new technologies for collaborative scientific inquiries into network science, working with the Army Research Laboratory and Army Research, Development, and Engineering Centers. In FY09, will conduct research on modeling and simulation of the human use of networks, communication, and command and control technologies to create semantic networks of common sense knowledge in tactical military settings. Will create new technologies to integrate the human, biological, mathematical, and engineered domains of network science, to extract higher level principles that illuminate each domain in new ways. In all years, research will be done in collaboration with the Army Research Laboratory and Army Research, Development, and Engineering Centers and with researchers at the Army's University Affiliated Research Centers, i.e., the Institute for Creative Technology at the University of Southern California, the Institute for Collaborative Biotechnology at the University of California, Santa Barbara, the Massachusetts Institute of Technology, and Carnegie Mellon University.				
Small Business Innovative Research/Small Business Technology Transfer Programs		85		
Total	2475	3338	3481	3505

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**F20**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
F20 ADV PROPULSION RSCH	1996	1935	2198	2253	2252	2260	2290	2342

A. Mission Description and Budget Item Justification: This project funds research to increase the performance of small air-breathing engines and power trains to support improved system mobility, reliability, and survivability, and ultimately serve to reduce the logistics cost burden for the Future Force. Problems addressed include the need for greater fuel efficiency and reduced weight in these propulsion systems. Technical barriers to advanced propulsion systems are the inadequacy of today's materials to safely withstand higher temperature demands, the lack of capability to accurately simulate the flow physics and the mechanical behavior of these systems, including the engine and drive train. The Army is the lead service in these technology areas (under Project Reliance) and performs basic research in propulsion, as applicable to rotorcraft and tracked and wheeled vehicles. Technical solutions are being pursued through analysis, code generation, experiments, and evaluations to improve engine and drive train components and investigate advanced materials. Component level investigations include compressors, combustors, turbines, energy sources and conversion, injectors, pistons, cylinder liners, piston rings, gears, seals, bearings, shafts, and controls. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
This research investigates new materials needed to withstand the higher temperature regimen of advanced high performance engines, and evaluates improved tools and methods that will accurately simulate the flow physics and the mechanical behavior of future engines and drive trains and enable the design of more fuel efficient and reliable propulsion systems. In FY06, evaluated diagnostics techniques for hybrid bearings (ceramic rolling elements with steel races); completed fatigue life analysis of a first stage ceramic matrix composite turbine; investigated thermal and environmental barrier coating systems with 3000F capability; transitioned unsteady compressor flow analysis code to industry. In FY07, analyze autonomous diagnostic and repair concepts for gas turbine engine components, and complete baseline experimentation of gear tooth bending strength at elevated temperatures experienced in helicopter transmissions. In FY08, will formulate life prediction models for low conductivity thermal barrier coatings to improve turbine design process and complete the face gear dynamic load prediction modeling computer code to improve the transmission design process. In FY09 will investigate synchronized speed control shifting algorithms that could enable variable speed helicopter transmissions and formulate diagnostic fault detection methods to improve the safety and reliability of helicopter transmissions.	1996	1935	2198	2253
Total	1996	1935	2198	2253

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H42**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H42 MATERIALS & MECHANICS	1983	2020	2198	2253	2309	2362	2408	2472

A. Mission Description and Budget Item Justification: This project funds the Army's basic research in materials science, which includes research into key phenomena enabling the creation and production of revolutionary materials that will provide higher performance, lighter weight, lower cost, improved reliability, and environmental compatibility for Army unique applications. The major issue associated with the current approach of using materials to gain added functionality for Army systems is that one must use a layered approach, whereby each layer provides added capability (i.e. ballistic, chem./bio, signature, etc.) but ultimately makes the system too heavy and too expensive. Technical solutions are being pursued through understanding the fundamental aspects of chemistry and microstructure that influence the performance and failure mechanisms of ceramics, advanced polymer composites, and advanced metals, with the goal of creating hierarchically organized materials systems that possess multifunctional attributes at greatly reduced weight and cost. These advanced materials will enable revolutionary lethality and survivability technologies for the Future Force. This research supports materials technology applied research in program element (PE), project 0602105A/H84. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DoD Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Devise new materials and design capabilities, based upon fundamental concepts derived at the microscopic and nano-structural levels, for the Future Force. In FY06, incorporated photonic materials and communications components into scaled survivable structures; used directed assembly techniques to control the nano-particle size and distribution of functional nano-particles in a polymer matrix; fully transitioned ceramic damage model to armor design codes; and performed ballistic experiments of a fracture resistant penetrator prototype designed using new fracture models. In FY07, enhance the synergistic effects of structure and electromagnetic interactions within scaled survivable structures, and characterize transport behavior and relevant properties of nanoparticles. In FY08, will implement and validate models for fragmentation, reactive materials, and ballistic penetration; enhance processing and non-destructive evaluation for improved armor ceramics; use directed assembly to embed functionality into polymer materials; and validate multifunctional material performance. In FY09, will perform comprehensive materials characterization for damage-tolerant sub-micron SiC ceramic materials, and develop 1st-generation phenomenological constitutive and failure model for SiC-N ceramic materials for armor.	1983	2020	2198	2253
Total	1983	2020	2198	2253

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H43**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H43 RESEARCH IN BALLISTICS	6536	5775	6142	6130	6187	6223	6364	6509

A. Mission Description and Budget Item Justification: This project seeks to improve understanding of the chemistry and physics controlling the propulsion, launch, and flight of gun launched projectiles and missiles, and to understand the interaction of these weapons with armored targets. This research results in basic new knowledge, which allows the formulation of more energetic propellants, more accurate and non-lethal/lethal projectiles and missiles, and advanced armors for increased survivability of Army combat systems for the Future Force. This effort supports the Office of the Secretary of Defense Advanced Energetics Initiative to mature the fundamental technologies required to transition the next generation of energetic materials into field use. This research supports survivability and lethality technology applied research in program element, project 0602618A/H80. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In support of the National Advanced Energetics Initiative, expand and validate physics-based models and experimental techniques to enable design of novel insensitive propellants/explosives with tailored energy release for revolutionary Future Force survivability and weapons effectiveness. In FY06, devised condensed phase novel energetic materials models to couple and describe energy releasing processes across the length scales for propellants/explosives; characterized nano-scale energetics in various stages of decomposition; devised functionally-graded nano-energetics; and modeled effects of plasma ignition on multiple propellant grains. In FY07, devise predictive meso/multiscale molecular models for design of insensitive propellant/explosive formulations; characterize/model ignition and combustion of multi-purpose reactive materials; and derive computational theory for energy storage and release mechanisms in energetic, strained solids/metastable states. In FY08, will simulate energy transfer and conversion within shocked and heated energetic materials formulations; fabricate and characterize reduced sensitivity nano-engineered energetic materials; derive theoretical descriptions and produce hyper-energetic polymeric nitrogen; characterize structural bond energy release materials; and refine models to include hot fragment impact, shear ignition sensitivity, emerging multiphase fluid dynamics, thermo-mechanical coupling, and reactive materials initiation. In FY09, will design smart, molecularly engineered energetics; design insensitive, nano-reactive energetic materials/structural energetic composites; differentiate initiation reactions caused by conductive versus shear stimuli; explore turbulent mixing and combustion in late-time energy release; and characterize sensitivity and performance of insensitive warhead explosive fills and validate refined propellant models.	3404	2770	2751	2723
Improve the fundamental understanding of the mechanisms controlling the launch and flight of gun launched projectiles and missiles, and understand the interaction of these weapons with armored targets. In FY06, proved ability to accurately depict the degradation of ceramic materials in controlled high-rate experiments; devised generalized failure framework for combined fracture and shear localization of metallic materials; and showed bank-to-turn maneuver during vehicle thrust using coupled computational fluid mechanics, rigid body dynamics and guidance, navigation, and control. In FY07, prove ability to accurately depict the degradation of ceramic materials in the terminal effects environment; apply the generalized fracture framework to simulate failure penetrators and armor materials; and study failure and damage of urban structural materials for terminal ballistic events. In FY08, will quantify damage in select ceramics using destructive and non-destructive techniques; devise reactive material ignition model; devise a controlled fragmentation model; and	2861	2522	2511	2509

implement models for urban structural material failure in continuum codes. In FY09, will devise 1st-generation physically consistent phenomenological constitutive and failure model for select damage-tolerant ceramics; implement both controlled fragmentation and reactive material ignition models into a continuum mechanics code; and model effects of secondary debris on humans and compare model results with actual human injury data obtained from the medical community.				
Extramural research in non-lethal (NL) control methods to exploit potentially innovative approaches that offer unique battlefield and homeland defense capabilities. In FY06, conducted research with the aim of understanding kinetic energy effects on the human with the aim of temporarily incapacitating the aggressor. This research focused on a macroscopic level understanding of the response of human tissue and/or protective clothing against ballistic impacts. It addressed the mid-to-high-strain rate behavior of soft materials including clothing and human tissue as well as hard protective materials such as ceramics. Developed micro-machined vacuum electronic devices operating at 94 GHz and demonstrated use of large area single mode fiber for high energy laser emission. In FY07, employ efforts to increase computational horsepower, and advances in tissue engineering to develop integrated modeling and experimental approaches to link kinetic energy loading conditions to human injury at the macroscale. Design and fabricate diffractive optical elements for better light extraction from high energy laser slabs. In FY08, will exploit advances in biotechnology to develop more refined modeling and experimental techniques to ascertain the effects of blunt trauma and impulse loading at the cellular level. Will attempt to coherently combine multiple optical fibers to enhance high intensity laser output at kilowatt levels. In FY09, will focus research efforts on bridging gaps that link these governing mechanisms and lay the groundwork for the prediction of overall response, including human functions such as cognitive and physical performance. Will attempt to demonstrate man-portable microwave sources operating at 94 GHz for active denial and crowd control, intending to leverage the development of the micro-machined VE sources in FY06.	271	400	880	898
Small Business Innovative Research/Small Business Technology Transfer Programs		83		
Total	6536	5775	6142	6130

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H44**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H44 ADV SENSORS RESEARCH	3708	3516	4023	4185	4281	4313	4363	4505

A. Mission Description and Budget Item Justification: This project funds basic research to enable new sensing capabilities for the Army's Future Force and to produce future generations of sensors with capabilities beyond those currently being employed. Technical barriers include the fundamental speed and bandwidth limitations of current materials and devices, the efficiency of current algorithms, current computing architectures, organic material lifetimes, the understanding of the fundamental concepts of quantum cryptography, and spatial resolution of current Radio Frequency (RF) sensors. The technical approach is to exploit large scale electromagnetic (EM) models to predict and explain target and clutter scattering behavior, digital and image processing modules and algorithms, beam propagation and material modeling of nonlinear optical effects, hazardous material detection, remote sensing and intelligent system distributive interactive simulations, and battlefield acoustic signal processing algorithms. Research performed under this project supports survivable sensor systems, affordable rugged flexible displays, and hazardous material monitoring, both point and remote. Payoffs include low cost compact flexible displays for the soldier and for the Army's Future Force, improved radar signal processing techniques that will allow existing systems to improve spatial resolution, improved ultra wideband (UWB) radar technology for detection of explosives including mine detection, through the wall sensing and robotics perception, improved signal processing techniques for acoustic/seismic sensing systems, improved cryptography techniques, and hazardous material sensing. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DoD Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL)

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Research addresses the maturation of technologies for adaptive, active, and intelligent optical systems for high-data-rate military communications and directed energy applications. In FY06, investigated adaptive compensation techniques and performed advanced analysis of target-in-the-loop scenarios with both cooperative and non-cooperative targets. In FY07, perform research into the use of an active Hybrid/RF/optical laser communications and imaging network for Army applications including laser designation and explosives detection. In FY08, will research potential configurations for small agile adaptive apertures for high-bandwidth optical communications and directed energy applications, and begin to define conformal adaptive optical components for Gigabit free-space laser communications and directed energy configurations. In FY09, will research parameters and define the operational envelop for the use of ultrashort (femtosecond) laser illumination for the Army's active imaging and directed energy applications.	1480	1327	1585	1658
Research focused on improving sensor capabilities to create more survivable/secure systems and displays, and improved hazardous material monitoring. In FY06, included the variability of soil characteristics in EM models to support assessments of forward-looking radar against explosive threats; investigated networking options of Quantum Cryptographic (QC) test beds and new areas in quantum information processing; and investigated sensitivity of magnetic field sensors; optimized fabrication parameters for maximum Surface Enhanced Raman Scattering (SERS) efficacy for hazardous material sensing; and transitioned organic light emitting device (OLED) blue emitters to the Flexible Display Center for evaluation. In FY07, use modeling and imaging tools to evaluate UWB image formation options; collaborate with RDEC partners to assess transition possibilities of QC systems; research decentralized signal processing for ad-hoc sensor networks; study noise in MEMS flux concentrators and accelerometers; and improve organic thin film transistor (OTFT) and photovoltaic performance for flexible displays. In FY08, will develop methods to mitigate sensitivity of imaging radar to multipath-	2228	2169	2438	2527

induced false alarms; conduct limited error rate analyses to assess the potential for compromising quantum systems; research distributed spatial and temporal processing and data fusion algorithms for networks of heterogeneous and possibly mobile sensor nodes; investigate new magnetic sensor technologies for personnel detection; and produce final SERS hazardous material sensing assessment report. In FY09, will research target and clutter scattering phenomena to support radar detection of a multitude of concealed targets; evaluate completed signal processing algorithms for networks of heterogeneous sensor nodes; assess biologically-inspired techniques for advanced photonic structures, and integrate OLEDs with OTFTs to investigate stability of system for next generation flexible displays.				
Small Business Innovative Research/Small Business Technology Transfer Programs		20		
Total	3708	3516	4023	4185

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H45**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H45 AIR MOBILITY	1959	1836	2295	2342	2366	2385	2437	2491

A. Mission Description and Budget Item Justification: This project supports basic research in aerodynamics for manned and unmanned rotary wing aircraft. The goal of this effort is to develop improved tools and methods to analyze, evaluate, and test rotorcraft unique aerodynamic properties in conventional helicopter and tilt rotor aircraft. The efforts in this project will result in a better understanding of rotorcraft aeromechanics and will result in improved performance, safety and, ultimately, improved combat effectiveness of the manned and unmanned rotorcraft in the Future Force. This project supports the Future Force by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing aircraft. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (BRP). Work in this program element is performed by the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, investigated rotor power required during high advance ratio flight for high-speed rotorcraft application, explored new acoustic prediction code for maneuvering flight, measured hub drag improvements using vortex generators. In FY07, demonstrate tightly coupled CFD/CSD methods for calculating helicopter airloads and structural loads in maneuvering flight. Explore aeromechanical benefits and issues for advanced rotorcraft configurations. In FY08, will develop new methods for accurate aeroelastic stability prediction. Will explore rotor fuselage interactions for complex configurations using advanced CFD methods. Will investigate aeromechanics issues for high altitude rotors. In FY09, will demonstrate active rotor modeling tool using National Full-scale Aerodynamic Complex validation data, develop improved turbulence models for rotorcraft application and assess improved modeling and simulation tools on heavy-lift interactional aerodynamics validation data.	1959	1803	2295	2342
Small Business Innovative Research/Small Business Technology Transfer Programs		33		
Total	1959	1836	2295	2342

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H47**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H47 APPLIED PHYSICS RSCH	2603	2453	2807	2873	2906	2930	2971	3063

A. Mission Description and Budget Item Justification: This project performs basic research on electronic materials and structures as well as energetic batteries and fuel cells to enable higher performance and more efficient electronic systems. This includes nanoelectronic devices for low-power and high-frequency applications; sensors, emissive nonlinear and nanophase electrode and electronic materials; thin heterostructure systems where quantum confinement effects are important; advanced batteries and more efficient fuel cells for hybrid power; and the manipulation of cold atoms on a chip for application to very sensitive sensors and ultra-stable atomic clocks. These investigations will impact the development of power sources and specialty electronic materials for the Army's Future Force, including improved wide band gap semiconductor performance in electric vehicles and advanced radar systems. Applications of cold atom chips include gyroscopes and accelerometers for inertial navigation units, gravitational sensors for detecting underground facilities, very-low-phase noise precision oscillators for low-velocity Doppler radar, and atomic clocks for space applications. Technical barriers affecting performance, weight, cost, and power consumption will be addressed. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
This research focuses on nanoelectronic devices and sensors; materials for advanced batteries; fuel cells and reformers for Soldier and vehicle power; electronic materials structures and defects of high-temperature wide-band-gap semiconductors for high-power electronic applications; and cold-atom chip devices for advanced sensors and ultra-stable atomic clocks. In FY06, experimentally validated selective area growth of carbon nanotubes (CNT) for heat extraction, designed and fabricated a CNT-based transistor, created a cold-atom cloud in a magneto-optic trap - a first step to atom chip sensors and clocks; explored Li-ion battery lectrolytes for use at low temperatures; and investigated a sorbent for sulfur removal from JP-8 fuel. In FY07, investigate the fabrication and characterization of prototype CNT and other nanowire-based sensor devices, create a protocol for determining fundamental failure mechanisms in Silicon Carbide (SiC) and Gallium Nitride (GaN) Schottky diodes, and evaluate the improved SiC and GaN devices in test circuits; trap a cold-atom cloud on a chip and transport the cloud using optical tweezers and a magnetic waveguide to construct miniature sensors; explore highly reversible electrode materials for fast charge of Li-ion batteries, design efficient air-electrodes for lithium/oxygen cells, and explore sulfur tolerant catalyst for JP-8 reformation. In FY08, will investigate CNT and other nanowire-based active electronic devices, explore thermal characteristics of relevant nanostructures, and detect atom interference in a waveguide; will investigate regenerable sulfur sorbents for JP8 reformation and materials for high power Li-ion batteries. In FY09, will investigate system insertion for nanoelectronic devices and sensors and failure mechanisms for wide-bandgap electronic devices; will sense a gravitational field gradient using a waveguide atom interferometer for possible use as inertial navigation; and will study thin-film battery materials.	2603	2443	2807	2873
Small Business Innovative Research/Small Business Technology Transfer Programs		10		
Total	2603	2453	2807	2873

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H48**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H48 BATTLESPACE INFO & COMM RSC	5366	6158	6720	6870	6999	7038	7123	7261

A. Mission Description and Budget Item Justification: This project supports basic research to enable intelligent and survivable command and control, communication, computing, and intelligence (C4I) systems for the Future Force. As the combat force structure becomes smaller and operates in more dispersed formations, information systems must be more robust, intelligent, interoperable, and survivable if the Army is to retain both information and maneuver dominance. This research supports the Army's new Network Science initiative and in the process addresses the areas of information assurance, the related signal processing for wireless battlefield communications, document and speech machine translation, and intelligent systems for C4I. Major barriers to achieving the goals are the inherent vulnerabilities associated with using standardized protocols and commercial technologies while addressing survivability in a unique hostile military environment that includes highly mobile nodes and infrastructure, bandwidth-constrained communications at lower echelons, resource-constrained sensor networks, diverse networks with dynamic topologies, high-level multi-path interference and fading, jamming and multi-access interference, levels of noise in speech signals and document images, new low-density languages, and information warfare threats. The intelligent systems for C4I research will focus on providing the agent technology capabilities that will produce highly relevant tactical events for mounted/dismounted commanders/leaders/Soldiers, improve the timeliness, quality and effectiveness of actions and, in the long run, speed the decision-making process of small teams operating in complex natural or urban terrain. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Perform research to provide communications capability for a fully mobile, fully communicating, situationally aware force operating in a highly dynamic, wireless, mobile networking environment populated by hundreds to thousands of networked nodes. In FY06, conducted laboratory experimentation to mature networking technologies (i.e. component based routing, performance, and scaling, robustness) using network visualization, logging, and analysis tools for adaptive communications in a mobile, wireless, tactical network. In FY07, analyze experimental data, to determine scalable routing algorithms for protocols (proactive/reactive) using communications traffic and topology scenario generation. In FY08, will refine scalable algorithms to incorporate technologies in sensor radios. In FY09, will perform experimental analysis to incorporate technologies in mobile radio units.	1514	1433	1605	1653
Design and implement a laboratory scale common information-processing infrastructure, inclusive of service oriented architecture for networking processes that aids in the transformation of data into actionable intelligence to support decision-making under uncertainty. In FY06, designed algorithms to detect tactical behaviors through mining for patterns/events over time/space and began 3D scene reconstruction using geometry/texture from a moving robotic platform. In FY07, implement first-order laboratory experiments to evaluate and enhance algorithms describing agent generated patterns and events used to refine and optimize algorithms for 3D scene reconstruction from a robotic platform. In FY08, will investigate the application of information mediation service techniques to produce fused actionable intelligence for military mission planning and execution such that data providers, including robotic sensors, Soldiers, and agency-based data systems, are connected using service oriented architecture networking techniques and information agents. Investigate pose recognition from imagery to determine location in GPS-denied areas. In FY09, will experiment with and evaluate 3-D scene reconstruction and pose recognition for enhanced situational awareness, along with information mediation improvements to the military	1336	1244	1399	1448

operational and tactical decision and planning process.				
Perform research in protecting information in highly mobile wireless tactical environments with severe bandwidth, energy, and processing constraints and operating without reliance on centralized security services. In FY06, performed research on intrusion detection in Mobile Ad Hoc Networks (MANETs) that addressed tradeoff issues in power, bandwidth, computation, and connectivity. In FY07, investigate high mobility, channel impairment issues which are MANET-unique. Algorithms will be tailored to MANETS that are severely constrained including topology variation and fading wireless channels. In FY08, will design and evaluate intrusion detection algorithms on mobile ad hoc networking protocols, including under hostile conditions, using formal methods to represent protocols. In FY09, will design and evaluate analytically and via simulation/emulation, robust classes of algorithms that will provide a dynamic architecture that will support detection of attackers under conditions of mobility.	1554	1448	1621	1671
Design and implement a laboratory scale common information-processing infrastructure that commanders and troops can use to bridge language barriers in order to anticipate adversaries' behaviors and collaborate with allies. In FY06, performed laboratory demo of low-density automated language translation and refined evaluation metrics for machine translation. In FY07, refine and optimize algorithms for automated language identification of speech and document machine translation and link test bed with AFRL and NRL. In FY08, will investigate, evaluate, and implement Service Oriented Architecture (SOA) concepts required to transition language technologies to Deployable Harmony Document Exploitation (DOCEX) System (DHDS) and Distributed Common Ground System-Army (DCGS-A). In FY09, will experiment with algorithms for processing and exploiting handwritten documents such as Arabic and Farsi, which are input to machine translation.	962	1005	1095	1098
Beginning in FY07, study the behavior of MANETs as part of the Army's new initiative on Network Science. Emphasis will be on mobile communications networks for the Army's University Affiliated Research Center, the Institute for Collaborative Biotechnology at the University of California - Santa Barbara. In FY08, will design formal models, abstractions, and metrics for mobile ad hoc networking and extend to simulations, and conduct scalability analyses and design models of mobile ad hoc routing protocols and their functional concepts, incorporating biological paradigms where applicable. In FY09, will conduct component-based performance modeling and analysis of routing protocols and design networking protocols that adapt to varying operating environments in order to optimize performance.		1000	1000	1000
Small Business Innovative Research/Small Business Technology Transfer Programs		28		
Total	5366	6158	6720	6870

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H57**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H57 SCI PROB W/ MIL APPLIC	58285	59295	56840	58406	59416	59477	61104	62566

A. Mission Description and Budget Item Justification: This extramural research project seeks to discover and exploit new scientific opportunities and technology breakthroughs, primarily at universities, to improve the Army's Transformational Capabilities. Current technologies are unable to meet the operational requirements of the Future Force. The Army Research Office of the Army Research Laboratory maintains a strong peer-reviewed scientific research program through which leap-ahead technological solutions may be discovered, matured, and transitioned to overcome the technological barriers associated with next generation capabilities. Included are research efforts for increasing knowledge and understanding in fields related to long-term Future Force needs in the physical sciences (physics, chemistry, biology, and materials science), the engineering sciences (mechanical sciences, electronics), and mathematical and information sciences (mathematics, computer, and information sciences), environmental sciences (atmospheric and terrestrial sciences), and the Army's new initiative - Network Science. Targeted research programs in nanotechnology, smart structures, multifunctional and microminiature sensors, intelligent systems, countermine, compact power, and other mission-driven areas will lead to a Future Force that is more strategically deployable, more agile, more lethal, and more survivable. The breadth of this basic research program covers approximately 900 active, ongoing research grants and contracts with leading academic researchers and approximately 1,600 graduate students yearly, supporting research at nearly 200 institutions in 46 states. This project also funds assessments of international technologies. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Basic research in environmental and life sciences Soldier performance, Soldier protection, and novel biotechnologies and biomaterials for new Army capabilities. In FY06, exploited advances in genomics, proteomics, and systems biological capabilities to understand the molecular basis of Soldier cognitive and physical performance, high performance biomaterials for Army use and host-pathogen interactions to counter new natural or man-made biological threats; exploited advances at the interface of molecular biology and nanoengineering to develop new electronics capabilities, and formulated atmospheric boundary layer models to improve nighttime forecasts. Researched environmental phenomenology associated with landmine emplacement, and extended statistical signal processing techniques and inverse scattering algorithms to improve landmine and unexploded ordnance (UXO) detection. In FY07, investigate new bioremediation approaches to maintain usable Army training facilities with reduced Soldier toxin exposure and operational and environmental compliance costs; advance capabilities in bionanoengineering, neurophysiology, and molecular biology for improved Soldier protection; devise airborne Doppler lidar with 4-D wind measurement capabilities; develop new simulations for soil moisture estimation; develop understanding of phenomenological modeling approaches applicable to various sensor types to discriminate low-metal targets and buried UXO from anthropogenic environmental clutter and to separate closely spaced object sensor signatures; and improve explosives detection from airborne surveillance imagery. In FY08, will focus on lower cost technologies for bioremediation, on biomaterials for better Soldier protection and on landmine and UXO detection. In FY09, will focus on new biotechnologies for soldier protection; bionanoengineering for new biomaterials; and devise a Soldier scale atmospheric test bed addressing unique atmospheric Army operational needs.	6122	6165	6030	6233
Basic research in chemical sciences for advanced power generation, propellants, protective materials, and threat detection. In FY06,	6397	6138	6003	6205

developed polymers, fibers and novel architectures for materials with superior protection from all environments; advanced fuel cell electrocatalysts and electrolytes; and codes for prediction of materials properties. In FY07, increase research on selective transport, systems integration of compact power sources, and multi-scale modeling for materials damage based on molecular interactions. In FY08, will emphasize research on fuel reformers, molecular control for chem./bio/explosive detection, and new initiative on chemical information theory for armor materials. In FY09, will focus on optimum design for chemically reacting systems, microreactors for threat detection and health assessment, and structure/function relations for membrane transport.				
Basic research in physics for precision guidance, superior optics, and signature management properties, ultra-sensitive sensors, quantum computing, and secure communications. In FY06, devised a theory for a communications protocol to send secure images; obtained highest laser intensity ever (1022 W/cm2); demonstrated low energy ion scattering techniques to measure quantum-confined electronic states of nanostructures; generated multiple qubit operations; generated single photons on demand; demonstrated quantum teleportation, error correction, and quantum Fourier transform operations in ion trap; attained first steps in quantum simulations; grew quantum cascade lasers structures by Metal Oxide Chemical Vapor Deposition. In FY07, devise negative index materials and photonic materials in the visible range for imaging & sensing applications; provide accurate computational tools to aid in design of new drugs and functional materials, beginning the process of subsuming biochemistry and quantum biology for a firmer basis for nanoscience; explore existence of new superfluid matter w/unequal spin; develop theories to determine quantum phases/phase transitions & controls to simulate condensed-matter. In FY08, will develop negative-index materials w/attempts to build flat lenses & demonstrate sub-wavelength images; explore 1 to 2 band loading of optical lattices; conduct preliminary simulations of Hubbard & Heisenberg models; develop continuously tunable microwave filters & sources (10-100 GHz) for communications & imaging RADAR. In FY09, will develop novel quantum cascade lasers & IR photodetectors for remote Chem/bio detection (CBD), enhanced Light Detection and Ranging (LIDAR) for target tracking, and high power (>100 KW) fiber lasers; will explore use of light filament based sensors for remote CBD, environmental sensing by novel enhanced spectroscopies, solar power at greater than 50% conversion efficiency (as a Soldier power source), and free space communications.	8864	8312	8154	8378
Basic research in electronics, photonics, and communications for unmatched networked Command, Control, Communications, and Computing and Intelligence, Surveillance, and Reconnaissance (C4ISR) capabilities. In FY06, established the feasibility of achieving thermoelectric cooling using HgCdTe-based materials grown by molecular beam epitaxy. In FY07, devise an integrated nano-scale sensor platform at THz frequencies for biological detection. In FY08, will complete a comprehensive model providing fundamental insights into high power quantum dot lasers. In FY09, will develop extremely small tactical antennas operating with high system efficiency across the HF, VHF, and UHF bands.	13033	12881	12673	12941
Basic research in mechanical and material sciences for survivable armor, more lethal anti-armor, improved mobility, and flexible displays for Soldier systems. In FY06, devised planetary gear analysis tools for improved rotorcraft transmissions; formulated practical micro active flow control schemes for transonic/supersonic projectiles to improve accuracy; explored new concepts of phase inter-compatibility for maturation of passively "smart" materials; synthesized first reversible aluminumphilic peptide to provide controlled adhesives for paints and other surfaces; devised inexpensive nanocomposite ceramic materials with novel plasma processing; devised inexpensive nanocomposite ceramic materials with novel plasma processing; created a novel nanomechanical testing technique to investigate the viscoelastic properties of ultra thin polymer films; established new diffraction methods for understanding the structure and function of organic molecules. In FY07, create adaptive multiple scale computational models to predict material failure; synthesize carbon nanotube-based damping polymers for vibration reduction in rotor blades; investigate optical switching behavior in novel polymer architectures and excited-state systems for laser protective films; fabricate fully dispersed single-wall carbon nanotube composites, devise the first simultaneously ferroelectric and ferromagnetic materials; synthesize prototype electron gas piezoelectric sensors. In FY08, will obtain full flowfield diagnostics around an oscillating rotor blade under realistic helicopter flow conditions; perform precise experiments and detailed	13469	12474	12270	12534

simulations to understand the dynamic response and failure of multilayered micro-electro-mechanical systems (MEMS) at both the material and structural levels. In FY09 will validate chemical kinetic mechanisms for high temperature and pressure alternative hydrocarbon-based fuels in diesel and turbine engine application.				
Basic research in mathematical and computer sciences as the backbone for complex, multi-system analysis, modeling and simulation, and information systems. In FY06, implemented complex geometric algorithms for searching, line of site, and route planning for the One Semi-Automated Force (OneSAF) training simulation and established fundamental results for algorithms to run on Graphics Processing Unit/Central Processing Unit (GPU/CPU) systems. Developed image processing software for targeting and terrain modeling, developed algorithms for fusion of electro-optical and millimeter wave data for concealed weapons detection, developed algorithms to support rotorcraft formation flying based on a non-linear predictive control model with formation manager. In FY07, develop intelligent processing systems to improve fusion of hard (sensor)/soft (human) information, and also to exploit the network centric nature of the fusion problem. In FY08, will develop a theory to support creation of tools for design of heterogeneous swarms for desired tactical emergent behavior. In FY09, will demonstrate the effectiveness of the developed products and tools on swarming in laboratory test-beds.	10400	10430	10250	10495
Basic research to gain an understanding of the fundamental aspects of how networks develop, function and adapt to environmental pressures and the rate of information flow across the network in manmade and naturally occurring networks. In FY07, perform basic research to extract the common elements of networks across various disciplines, perspectives, layers, theories, and applications to create a sound basis for a science of networks. The science is aimed at developing theoretical models that can explain and predict network behavior. In FY08, will explore the science aimed at developing experimental/theoretical/computational models that can explain and predict the overall behavior of the layered structure of networks of importance to the Army. At the base of the layer cake is the physical network, followed, for example, by the information network, then the communication network and terminating in the social network, with multiple nonlinear interactions within each layer and among the various layers. In FY09, will examine candidate mechanisms by which different layers interact with one another. In particular a universal representation of information (information theory, metrics, topology, etc.) within physical, biological, and social networks will be constructed to enable network interfacing and control across multiple scales. Moreover the barriers (lack of mathematical infrastructure) to network control across multiple scales will be addressed in this general information context.		1540	1460	1620
Small Business Innovative Research/Small Business Technology Transfer Programs		1355		
Total	58285	59295	56840	58406

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H66**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H66	ADV STRUCTURES RSCH	1485	1513	1619	1659	1700	1740	1773	1820

A. Mission Description and Budget Item Justification: This project funds basic research for improved tools and methods to enable the design and use of composite structures that can better address the cost, weight, performance, and dynamic interaction requirements of future platforms identified by the Army Modernization Plan. Ultimately, these technologies result in safer, more affordable vehicles with a greatly reduced logistics footprint. This project is a joint Army/NASA effort that includes structures technology research into: structural integrity analyses; failure criteria; inspection methods which address fundamental technology deficiencies in both metallic and composite Army rotorcraft structures; use of composite materials in the design and control of structures through structural tailoring techniques; rotorcraft aeroelastic modeling and simulation; helicopter vibration (rotating and fixed systems); and the design and analyses of composite structures with crashworthiness as a goal. The problems in structures are inaccurate structural analysis and validation methods to predict durability and damage tolerance of composite and metallic rotorcraft structures and inadequate structural dynamics modeling methods for both the rotating and fixed system components to address reliability issues for future aircraft. The technical barriers include a lack of understanding of failure mechanisms, damage progression, residual strength, high-cycle fatigue, the transfer of aerodynamic loads on the rotor to the fixed system, and impact of these unknown loads on aircraft components. Technical solutions are focused on: advanced fatigue methodologies for metallic structures, improved composites technology throughout the vehicle, long-term maturation of integrated stress-strength-inspection, advanced methods for rotor system vehicle vibratory loads prediction, improved methods to predict vehicle stability, and improved analyses to address Army Aviation requirements. These advancements will extend service life, reduce maintenance costs, enhance durability, and reduce the logistics footprint of existing and future Army vehicles. As agreed under Project Reliance, this is the only project for rotorcraft and ground vehicle structures basic research within DoD. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
This research devises new structural analysis and validation methods to more accurately predict durability and damage tolerance of composite and metallic rotorcraft structures, and evaluates structural dynamics modeling methods to address critical reliability issues in the rotating and fixed system components of future aircraft. In FY06, performed modeling and simulation studies of active control concepts for heavy lift rotorcraft; and conducted subcomponent experiments to validate durability and damage tolerance predictions for composite structures with embedded sensors/actuators. In FY07, conduct wind-tunnel experiments of innovative rotor configurations applicable for heavy lift rotorcraft to characterize structural and aeromechanical performance; explore advanced concepts for lightweight, highly tailored and multi-functional composite structures using embedded sensors/actuators. In FY08, will analyze computational fluid dynamic methods to support unsteady low Reynolds number aerodynamic models for flapping wing Microsystems. In FY09 will evaluate multibody-compatible thin-walled elastic finite element methods to enable aeroelastic predictions for small scale air vehicle systems.	1485	1513	1619	1659
Total	1485	1513	1619	1659

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**S13**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
S13 SCI BS/MED RSH INF DIS	9345	8518	10497	10889	10247	10313	10540	10772

A. Mission Description and Budget Item Justification: This project supports basic research that provides for healthy, medically-protected Soldiers for the Future Force. This research investigates medical countermeasures for naturally occurring diseases that have had historically severe impacts on military operations. Malaria is the most significant military infectious disease threat. The malaria parasite becomes resistant to fielded drugs making it necessary to continually search for new drugs to feed the development and licensure pipeline. A vaccine to prevent malaria infection would be ideal but has been elusive, requiring additional basic research for novel vaccine approaches. Basic research to discover what components of an infectious organism causes disease and how the human reacts to these organisms will provide new approaches to prevent disease. In addition, identification of unique features of disease organisms will aide in developing diagnostics tools. Research into the transmission of disease by insects and other organisms (vectors) that carry the disease organisms will help to direct new interventions into preventing disease transmission. The Army is the Department of Defense's lead service for military infectious diseases research, and work in this project is managed by the US Army Medical Research and Materiel Command. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DoD Basic Research Plan (BRP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD, and its overseas laboratories; the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; and the Naval Medical Research Center (NMRC), Silver Spring, MD, and its overseas laboratories.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Prevention/Treatment of Parasitic Diseases: Conduct basic research to better understand malaria parasites, a necessary foundation to discover medical countermeasures to protect Soldiers from infection. In FY06, designed chemical compounds using predictive computer modeling, screened over 3000 drugs for antimalarial activity, and selected several candidate compounds for additional study. Established a technology for synthesizing individual malaria proteins identified through genomic databases without any need of the living parasite; these proteins will allow for small scale testing of malaria countermeasures. Used a mouse model to identify several new malarial proteins to assess as potential vaccine candidates. In FY07, design and screen new drug compounds and new parasite molecules (such as proteins critical for parasite growth) as malaria drug targets. In FY08, will continue molecular approaches to find new technological advances to address malaria continue with modeling and screening thousands of drugs for antimalarial activity; search for new malaria proteins as drug targets and vaccine candidates. In FY09, will apply new technologies as they become available to identify novel approaches to attack malaria, such as improved computer modeling for drug discovery, and bioinformatics to better identify important parasite genes and proteins that can be used for drug screening and vaccine targets.	3040	3758	4234	4703
Bacterial Threats Vaccine Programs: Conduct basic research to better understand the biology of bacterial organisms and how to prevent diarrhea and scrub typhus. In FY06, studied possible factors that increase the warfighter's risk or probability of contracting diarrhea (such as the genetic makeup of bacterial strains), and incorporated these findings into the Diarrheal Vaccine Program. Studied a newly discovered layer in the cell wall surface of the Campylobacter bacterium (a cause of severe diarrhea) to understand its chemistry and potential for use in developing a vaccine. In FY07, conduct basic research to understand how bacteria cause diarrhea (such as interactions between bacteria and humans), with a focus on discovering new approaches to prevent diarrheal diseases. In FY08, will conduct basic research to expand discoveries/studies of those bacterial components that are integral in the disease process and assess them as potential	802	777	1832	1802

vaccine or other countermeasure candidates. Will also assess proteins from the scrub typhus organism to better define their roles in causing disease and use as potential vaccine targets. In FY09, will continue to assess the proteins and other components expressed on diarrheal and scrub typhus organisms for their roles in disease and possible use in protection.				
Viral Threats Vaccine Programs: Conduct basic research to better understand highly lethal or incapacitating viruses, including those that cause hemorrhagic diseases (leakage of blood from vessels), such as dengue hemorrhagic fever and hantaviruses like Korean hemorrhagic fever. Basic research includes global risk to the warfighter, virus biology, disease process, and interaction with human body. In FY06, continued to identify viral and human factors that determine the hemorrhagic outcome of dengue fever; continued to study the mechanisms the human body naturally uses to protect against hemorrhagic viral diseases to better understand how to approach vaccine development. Studied individual human gene expression during vaccine responses to assess correlation of specific gene activity with vaccine protection. In FY07, conduct basic research to better understand hemorrhagic viruses and potential prevention approaches including studies of human-virus interactions between different dengue viruses that may affect vaccine strategies. Continue to study genes of highly lethal viruses to better understand which may provide protection if incorporated into a vaccine. In FY08, will perform long-term studies to understand how naturally induced changes in the virus impact the virus's ability to cause disease. In FY09, will conduct basic research to understand hemorrhagic viral diseases and other lethal viruses of military importance and to assess emerging viral threats for their potential to impact military operations to determine whether any identified new threat requires further studies.	1231	1284	1482	1844
Insect Vector Control and Infectious Disease Diagnostics Programs: Conduct basic research to investigate the biology of biting insects and other organisms that transmit disease (called disease vectors) and their control (including leishmania-carrying sand flies) and to expand medical diagnostic and disease surveillance capabilities in the field. In FY06, conducted field studies to identify new insect species responsible for transmitting malaria. Studied the response of insects to insecticides to better understand insecticide-resistance of disease bearing vectors. Demonstrated that the fat-tailed jird (a small rodent) can be use to study transmission of leishmania in the laboratory. In FY07, conduct basic research to identify suitable markers (proteins or other disease-specific molecules) for potential use in insect-based pathogen detection systems, and for field clinical diagnosis of human infection. Assemble insect identification keys for use by Preventive Medicine Units (PMUs) in CENTCOM region. In FY08, will conduct basic research to investigate the biology of insect vectors including vector identification, and assembly of insect identification aids for use by PMUs focusing on SOUTHCOM and PACOM regions. Study biology of insects to better understand ways to control them through novel repellents or insect attractants and insecticides. In FY09, will explore the biology of insect vectors and methods of control, in order to expand medical diagnostic and disease surveillance capabilities with a focus on providing new approaches.	4272	2602	2949	2540
Small Business Innovative Research/Small Business Technology Transfer Program		97		
Total	9345	8518	10497	10889

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**S14**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
S14 SCI BS/CBT CAS CARE RS	3996	3687	4517	4692	3990	4007	4097	4185

A. Mission Description and Budget Item Justification: This project supports basic research for healthy, medically protected Soldiers for the Future Force, focusing on a basic understanding of the mechanisms of combat-related trauma. This research identifies trauma-related topic areas for basic techniques and the experimental models necessary to support in-depth trauma research studies. Research conducted under this project forms the basis for the advancement of trauma treatment and surgical procedures to delay cell death and reduce bleeding following traumatic injury, minimize lost duty time from minor battle and nonbattle injuries, and provide military medical capabilities for far-forward medical/surgical care of battle and nonbattle injuries. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DoD Basic Research Plan (BRP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD, and the US Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, completed characterization and validation of a new combat-relevant model of ballistic-type brain injuries, began studies of the basic cellular responses to penetrating ballistic-type brain injury (PBBI); discovered a novel protein biomarker that can differentiate between different types of brain injuries; discovered a novel application for an experimental neuroprotectant drug, NNZ2566, to treat silent seizures caused by brain trauma; and continued collaboration with the National Heart, Lung and Blood Institute (NHLBI) on six studies supporting trauma care: (1) zinc compounds as carbon monoxide inhibitors to prevent circulatory collapse and maintain blood pressure, (2) a noninvasive tool for earlier recognition of tissue dysfunction or damage in a model of circulatory collapse, (3) very small doses of an oxygen carrying fluid to treat potentially fatal shock from blood loss, (4) direct peritoneal dialysis that can be quickly administered and easily stopped to halt post-trauma swelling, (5) animal hemoglobin molecules modified to prevent high blood pressure and decreased heart output, and (6) mechanisms for recovery from cardiovascular collapse that may provide adequate blood flow at the microcirculation level. In FY07, complete mechanism of action studies for NNZ2566, further define the role of brain inflammation and delayed cell death genes/proteins in secondary injury; and complete the collaborative studies with NHLBI. In FY08, will study the effect of novel neuroprotection therapies on cellular responses to injury, and continue molecular mechanism studies of PBBI to include studies to identify secondary insults that provoke electrical brain malfunction after a brain injury. In FY09, continue basic research in PBBI and delayed cell death mechanisms, and conduct preclinical biomarker studies to support early diagnosis of PBBI.	3996	3637	4517	4692
Small Business Innovative Research/Small Business Technology Transfer Programs		50		
Total	3996	3687	4517	4692

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**S15**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
S15 SCI BS/ARMY OP MED RSH	5623	5773	6318	6525	6246	6336	6524	6716

A. Mission Description and Budget Item Justification: This project supports basic research required to sustain a future force of healthy, medically-protected warfighters, including delineation of injury, sustainment, and enhancement of the physiological and psychological capabilities of military personnel under combat operations in all environments. The focus is on physiological and psychological factors limiting Soldier effectiveness and on the characterization of health hazards generated by military systems and resulting from military operations. This includes development of concepts for medical countermeasures to sustain performance when the opportunity for adequate rest is impaired or impossible due to combat conditions. Research is conducted on militarily relevant aspects of environmental physiology and the neurobehavioral aspects of stress. The hazards of exposure to several classes of non-ionizing radiation, directed energy, blast, jolt, vibration, noise, and toxic industrial chemicals as environmental contaminants are also investigated under this project. The six main thrust areas are (1) nervous system regulation of stress and cognition, (2) metabolic regulation, (3) control of regional blood flow, (4) oxidative stress interventions, (5) tissue remodeling/plasticity, and (6) biomechanical/biodynamic mechanisms of injury. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the DoD Basic Research Plan (BRP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA; and the US Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, identified and tracked functional changes to the eye resulting from laser-induced retinal injuries; identified potential interventions for laser-induced retinal injuries that will decrease injury rates and enhance Soldier survivability; identified current surgical therapies to be ineffective in treating laser-induced eye injuries. In FY07, explore, through an in-depth literature review, bone marrow-derived stem cell research as an innovative therapeutic mechanism for traumatic retinal injury and initiate identification and isolation of stem cells derived from bone cell injections. In FY08, if FY07 results support further study, will conduct bone marrow stem cell research as a potential therapeutic intervention for laser-induced eye injury. In FY09, explore the mechanism of stem cell interactions with laser induced injury to retinal cells by use of proteomics and genomics.	1494	1454	1510	519
In FY06, applied gene chip technology to explore the basis of individual differences in resilience during sleep loss and identified physiological indicators that could lead to innovative fatigue interventions. In FY07, expand the mathematical model for predicting performance to include individual differences between personnel. In FY08, will examine, within a laboratory environment, the individual components of the performance prediction model. In FY09, will refine the individual difference components in order to establish a more robust prediction model.	2653	1330	1170	2032
In FY06, examined model components and parameters required for investigation of the effects of prolonged exposure to cold, which indicated an increased susceptibility to injury and death. These findings will influence the development of cold weather doctrine. In FY07, explore cold-temperature regulation and its impact on physical activity. In FY08, will explore tissue protein analysis as a predictor of performance degradation from exposure to cold. In FY09, will investigate treatment interventions to reduce death and illness incidence rates resulting from environmental exposures to cold.	1476	2439	3138	3474

In FY07, begin developing computational approaches to identify networks of specific organisms and cellular processes in support of the Army's new initiative in Network Science. This work is conducted in close coordination with researchers at the Army's University Affiliated Research Center, the Institute for Collaborative Biotechnology, at the University of California, Santa Barbara. In FY08, will begin to characterize newly-discovered networks by developing new mathematical and computational methods that address identified gaps. Investigate whether protein-protein network models, developed for a particular pathogen, are portable to a different pathogen sharing a common set of proteins. In FY09, will transfer knowledge and techniques gained from studies of biological networks, by an inter-disciplinary team of physical science and life science researchers, to general physical networks.		500	500	500
Small Business Innovative Research/Small Business Technology Transfer Programs		50		
Total	5623	5773	6318	6525

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**T22**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T22 SOIL & ROCK MECH	1889	1787	2171	2213	2236	2252	2302	2352

A. Mission Description and Budget Item Justification: The objective of this basic research project is to correlate the effects of the micro-scale behavior on the macro-scale performance of geological and structural materials to provide a foundation for the creation of future revolutionary materials and to understand the sensor data within a heterogeneous geological system. This research encompasses geologic and structural material behavior, structural systems, and the interaction with dynamic and static loadings. Research includes: underlying physics and chemistry that controls the mechanics and electromagnetic behavior of geological and structural materials, new experimental techniques that provide measurements at the fundamental scale, and fundamental theories for relating micro-scale phenomena to macro-scale performance. This research provides the basis for applied research in program element 0602784A (Military Engineering Technology) project T40, Mobility/Weapons Effects Technology, that supports the civil engineering technologies for force projection, mobility, maneuver support, and survivability of the Future Force. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (BRP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Military Engineering Basic Research: In FY06, identified and characterized the magnetic properties of soils that can mask the detection of mines and unexploded ordnance. Developed techniques for improving the bond between concrete and steel. In FY07, determine the feasibility of biological stabilization of soil surfaces for rapid construction on these surfaces; produce techniques for optimizing hardening reactions in organic cements allowing them to become the basis for high-strength, lightweight composites; and produce a concept for low-velocity probe that could provide the capability to remotely determine soil properties. In FY08, will produce simulation capabilities for a full, dynamic, micro-scale air-water-solid system and for molecular dynamics of selected carbon nanotubes. In FY09, will extract macro-scale models from the micro-scale simulation capability (air-water-solid) and will produce final molecular dynamics modeling for the understanding of cement-based and ceramic materials.	1889	1774	2171	2213
Small Business Innovative Research/Small Business Technology Transfer Programs		13		
Total	1889	1787	2171	2213

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**T23**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T23 BASIC RES MIL CONST	1532	1440	1649	1713	1753	1815	1876	1948

A. Mission Description and Budget Item Justification: The objective of this basic research project is to support facilities research initiatives. The project is focused on forming an explicit and mathematically robust set of algorithms for geometrical reasoning; assessing the conceptual feasibility of applying nanoparticle technology to real-time sensors, thermal conductivity, and high strength materials; and developing novel and advanced concepts for mitigating the effect of chemical and biological agents in built structures. These efforts provide basic research leading to improved design in a range of facilities to optimize facility mission performance, enhance facility security, reduce design and construction errors and omissions, reduce resource requirements, and reduce the environmental burdens over the facility's life. This project provides leap-ahead technologies to solve military-unique problems in the planning, programming, design, construction, and sustainment of deployed facilities, and energy and utility infrastructure. This project supports exploratory development efforts in program element 0602784A (Military Engineering Technology) projects T41 and T45, Military Facilities Engineering Technology and Energy Technology Applied to Military Facilities. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Facilities Research: In FY06, investigated the efficiency of mechanisms in a semi-conducting optical system to detect and quantify simulants for spores, such as anthrax. Completed experimental measurements of anomalous enhanced thermal conductivity using carbon nanotube (CNT) nanoparticles. In FY07, develop physics based constitutive equations for heat transfer of fluids containing CNT nanoparticles. Mature molecular level design tool for CNT reinforced composite materials. In FY08, will develop robust model-based support for the "Sensing Through Walls" (STW) problem, taking into account critical high-level building design logic and constraints. Will determine the complex interactions between a forest edge and an acoustic wave, including the dependence on acoustic ground impedance, microclimate, and biomass structure. Will develop predictive understanding of blast wave interaction with man-made barriers. In FY09 will conduct experimentation to be used in developing next generation nanotechnology for facilities, sensor coatings, and constituitive models for micro-particle dispersion.	1532	1415	1649	1713
Small Business Innovative Research/Small Business Technology Transfer Programs		25		
Total	1532	1440	1649	1713

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**T24**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T24 SNOW/ICE & FROZEN SOIL	1273	1150	1422	1443	1460	1471	1503	1536

A. Mission Description and Budget Item Justification: The objective of this basic research project is to increase knowledge in the areas of terrain state and signature physics. Projects include fundamental material characterization, investigation of physical and chemical processes, and examination of energy/mass transfer applicable to predicting state of the terrain, which control the effects of the environment on targets and target background signatures and mobility in support of the materiel development community. It provides the knowledge base for understanding and assessing environmental impacts critical to battlespace awareness. The terrain state area of terrestrial sciences investigates weather-driven terrain material changes and sensing/inferring subsurface properties. The signature physics area of terrestrial sciences focuses on understanding the dynamic changes to electromagnetic, acoustic and seismic signatures, and energy propagation in response to changing terrain state and near surface atmosphere. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Terrain State and Signature Physics: In FY06, formulated a new invertible two-dimensional theory of low-frequency acoustic signal propagation that includes the relevant effects of reverberation, diffraction, and scattering to understand acoustic signature modulation between target and sensors and provide a potential means for non line-of-sight source detection. In FY07, investigate characteristic length scales (one to one thousand meters) of terrain response to atmosphere forcing, and relate to scale effects on electromagnetic and acoustic propagation. In FY08, will investigate how high frequency radio waves propagate over topographically and electrically complex ground (roughness); specifically, the degree to which roughness controls local and extensive RF coverage and develop theory to predict coverage given surface roughness and electrical variability. In FY09, will investigate the variance in disturbed and undisturbed soil physical, thermal, and optical properties to establish physical parameters that govern the signature response and variance in changing environmental conditions, thus optimizing below surface target detection in prevailing environmental conditions.	1273	1150	1422	1443
Total	1273	1150	1422	1443

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**T25**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T25 ENVIRONMENTAL RES-COE	4259	4531	5519	5625	5679	5719	5834	5951

A. Mission Description and Budget Item Justification: The objective of this basic research project is to investigate fundamental scientific principles and phenomena necessary to ensure efficient development of the technologies needed to address Army sustainment issues in the restoration, compliance, conservation, and non-industrial pollution prevention areas. These efforts include: investigating and monitoring contaminated sites, including chemical contamination and unexploded ordnance (UXO) detection/discrimination; better characterization of contaminants through improved risk-based assessment; destruction, containment, or neutralization of organics in water, soil, and sediments resulting from military activities; adhering to applicable federal, state, and local environmental laws and regulations; monitoring and controlling noise generation and transport; protecting and enhancing natural and cultural resources; reducing pollution associated with military activities; and the study of ecosystem genomics and proteomics in support of the Army's new Network Science initiative. The project supports applied research under program element (PE) 0602720A (Environmental Quality Technology), projects 048, 835, and 896, Military Environmental Restoration Technology, Industrial Operations Pollution Control Technology, Military Medical Environmental Criteria, and Base Facilities Environmental Quality. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). The US Army Engineer Research and Development Center, headquartered in Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Environmental and Ecological Fate of Explosives, Energetics, and Other Contaminants: In FY06, determined the potential mechanisms of toxicity and sub-lethal effects of individual and interactive mixtures of explosives. Used bioinformatics (computational biology) as the basis for constructing Deoxyribonucleic Acid (DNA) probes and to characterize DNA isolated from soil. In FY07, continue to establish a basic understanding of physical, chemical, and biological phenomena specific to contaminant toxicity assessment and environmental risk assessment. Initiate research to gain fundamental knowledge of ecosystem genomic and proteomic issues to understand how ecosystems form and maintain robust communication networks to ensure survival of their members. Identify DNA gene sequences involved in the anaerobic biodegradation and alterations of cell wall pass-thru proteins for use in probe biosensors for an explosive nitroamine (Cyclonite-RDX) and Perchlorate. Determine the physiological response of soil bacteria to identify protein biomarkers of Hexanitrohexaazaisowurtzitane (CL-20) exposure and metabolism. In FY08, will apply computational chemistry to identify molecular structural reactivity to predict degradation mechanisms and products and define the molecular mechanisms of neurotoxicity for an invertebrate neurobiology model to assess sublethal neurotoxic effects of CL-20 and other munitions constituents (MCs). Will investigate detection of biomolecule binding and cleavage events using biomolecules as switches for ultra-sensitive monitoring of MCs. Will identify chemical reactions between the DNA sequence and contaminant for applications toward contaminant-unique biosensors. Will integrate toxicogenomics data with biological network analysis to serve as a basis to identify mechanisms and interactive toxicity effects of MC mixtures. Will improve estimates of waterborne lead absorption, distribution, and subcellular partitioning in prey invertebrates and reptiles.	2576	2682	3336	3400
Remediation of Explosives, Energetics, and UXO: In FY06, used thermal desorption with ion trap mass spectrometry to relate the binding/transport properties of explosives to soil characteristics (geochemistry and soil mineralogy), in and on soils. Established the	1214	1260	1575	1606

relationship of explosives-energetics affinity of being bio/chemically transformed into other toxic/non-toxic chemicals using kinetic models. Refined UXO signature prediction capabilities with new models that enhance subsurface physical property characterization based on the overall geology of a site and related distributions and amplitudes of naturally occurring geophysical anomalies. Continued characterization of explosive degrading microbial communities using molecular methods. In FY07, identify RDX microbial and molecular interactions, regulatory genetic networks, breakdown modes and pathways, and novel signaling molecules that lead to improved capability to assess, control, design, and track progress of RDX bioremediation. Determine the physiological response of soil bacteria to identify protein biomarkers of CL-20 exposure and metabolism. Continue to establish a basic understanding of physical, chemical, and biological phenomena specific to contaminant mineralization. In FY08, will define mechanisms of high explosives movement through the unsaturated soil zone to the groundwater to support range management and remediation approaches. Will investigate the application of the unique physical, chemical, and biological interactions with the environment of DoD specific nanomaterials to potentially support advanced environmental technologies. Will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to contaminant mineralization. In FY09, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to contaminant mineralization.				
Training Land Natural Resources: In FY06, determined viable population levels of threatened and endangered species, as affected by the genetic diversity within populations, and quantified the amount of genetic exchange between populations due to habitat fragmentation. In FY07, define the fundamental relationships between landscape structure - habitat feature and effects on the genetic viability of threatened and endangered bird populations. Continue to establish a basic understanding of physical, chemical, and biological phenomena specific to ecosystem maintenance, mitigation, and rehabilitation. In FY08, will determine potential use of bioassay guided fractionation (BGF) to assess reptilian developmental and reproductive effects, toxicity, and risk of endocrine active compounds for a large number of contaminants. Will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to ecosystem maintenance, mitigation, and rehabilitation. In FY09, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to ecosystem maintenance, mitigation, and rehabilitation.	469	488	608	619
Small Business Innovative Research/Small Business Technology Transfer Programs		101		
Total	4259	4531	5519	5625

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601103A - University Research Sciences (H)**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	73707	80841	64843	66781	68696	69339	71625	73224
D55	University Research Initiative	64409	67787	64843	66781	68696	69339	71625	73224
D58	URI ACTIVITIES (CA)	5560	10087						
D63	INST OF BIOENGINEERING AND NANOSCIENCE IN ADV MED	959							
D66	MEDICAL UNIVERSITY RESEARCH INITIATIVES (CA)	2779	2967						

A. Mission Description and Budget Item Justification: This project supports Army efforts in the Multidisciplinary University Research Initiative (MURI) program, the Defense University Research Instrumentation Program (DURIP), and the Presidential Early Career Awards for Scientists and Engineers (PECASE) program by funding basic research in a wide range of scientific and engineering disciplines pertinent to maintaining the US land combat technology superiority. Army MURI program efforts involve teams of researchers investigating high-priority; transformational topics that intersect more than one traditional technical discipline (e.g. Intelligent Luminescence for Communication, Display, and Identification). For many complex problems, this multidisciplinary approach serves to accelerate research progress and expedite transition of results to application. The DURIP provides funds to acquire major research equipment to augment current, or devise new, research capabilities in support of Army transformational research. The PECASE program funds single-investigator research efforts performed by outstanding academic scientists and engineers early in their independent research careers. Project D58 includes funding for specific congressional interest University Research Initiatives. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work on this project is performed extramurally by the Army Research Laboratory (ARL).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601103A - University Research Sciences (H)**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	76984	68545	66507	67755
Current BES/President's Budget (FY 2008/2009)	73707	80841	64843	66781
Total Adjustments	-3277	12296	-1664	-974
Congressional Program Reductions		-309		
Congressional Rescissions				
Congressional Increases		13200		
Reprogrammings	-3277	-595		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1664	-974

Eleven FY07 congressional adds totaling $12652 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1916) Desert Environmental Research
($1054) Laboratory for Engineered Human Protection (LEHP)
($959) Low Temperature Research
($959) High Res Analyt Transmission Electron Microscope
($1246) Advanced Precision Supply Parts Manufacturing
($959) Collaboration Skills for Time Critical Teams
($959) Cyber Enabled Technology Program
($1725) Nanosystems Through Optical Biosensors
($959) Nanocrystal Therapeutic Agents & Screening Tools
($958) Nanomedical Technologies Research
($958) Physical & Behavorial Rehabilitation

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601103A - University Research Sciences (H)**	**D55**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
D55 University Research Initiative	64409	67787	64843	66781	68696	69339	71625	73224

A. Mission Description and Budget Item Justification: This project supports the Multidisciplinary University Research Initiative (MURI) and the Defense University Research Instrumentation Program (DURIP). The MURI program funds university basic research in a wide range of scientific and engineering disciplines pertinent to maintaining the US land combat technology superiority. Army MURI efforts involve teams of researchers investigating high-priority, transformational topics that intersect more than one traditional technical discipline (e.g. Intelligent Luminescence for Communication, Display, and Identification). For many complex problems, this multidisciplinary approach serves to accelerate research progress and expedite transition of results to application. The DURIP provides funds to acquire major research equipment to augment current, or devise new, research capabilities in support of Army transformational research. This program element also supports Presidential Early Career Awards for Scientists and Engineers (PECASE). The PECASE program funds single-investigator research efforts performed by outstanding academic scientists and engineers early in their independent research careers. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work on this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
MURI: In FY06, supported MURI awards made in prior years and made eight new awards. Topic areas for the FY06 MURI research competition include: Bio-integrating Structural and Neural Prosthetic Materials; Spatial-temporal Event Pattern Recognition; Self Assembling Metallic/Metalloid Cluster Materials; Optical Materials with Negative Refractive Index; Monolithic Silicon Microbolometer Materials for Uncooled IR Detectors; Ultrafast Switching for Optical Imaging, Ultrafast, Non-equilibrium Laser-Material Interactions; and Urban Target Recognition by Ad-hoc Networks of Imaging Sensors and Low-cost, Non-imaging Sensors. Topic areas for the FY07 MURI research competition: Biologically Synthesized Quantum Electronic Systems; Attosecond Subwavelength Optical Pulses; Designing and Prescribing an Efficient Natural-like Language for Bots; Ionic Liquid Containing Polymeric Materials; Self-healing Polymer Composites through Mechanochemical Transduction; Engineering of Phase Transforming Electromagnetic-Optical Materials; Robust and Resilient Tactical Mobile Ad-Hoc Network (MANET); Urban Sensor Network Structure For Data Fusion; Dynamic Modeling of 3D Urban Terrain; and Wide-band Gap Semiconductor Based Sensing for Detection and Response to Weapons of Mass Destruction Threats. In FY07, FY08, and FY09 continue to support MURI awards made in prior years and initiate new awards in research critical to the Army's future operating capabilities.	51011	51379	52882	55460
PECASE: Supported PECASE investigators started in prior years. In FY06, selected two new investigators. In FY07, FY08, and FY09 will select two new investigators each year.	910	958	992	998
DURIP: In FY06, the DURIP program awarded 64 competitive grants for the acquisition of research instrumentation under the Defense University Research Instrumentation Program (DURIP). In FY07, DURIP continues acquisition of instrumentation that enhances the current research infrastructure and provides new research capabilities to enable scientific exploration and discovery in promising areas vital to Army transformational technologies. In FY08 and FY09, DURIP will continue to fund competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation.	12488	13543	10969	10323
Small Business Innovative Research/Small Business Technology Transfer Programs		1907		

Total	64409	67787	64843	66781

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601104A - University and Industry Research Centers**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	96175	95748	84034	87814	88321	89818	91904	93777
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	4800	2598	2660	2732	2790	2847	2910	2974
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	6541	7039	7168	7319	7478	7627	7795	7966
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2406	2598	3066	3630	4367	4457	4590	4626
H50	Comms & Networks Collab Tech Alliance (CTA)	7139	7509	7032	7198	7489	7572	7655	7812
H53	ADV DIS INTR SIM RSCH	2309	2077	1985	1996	2000	2000	2072	2118
H54	Micro-Autonomous Systems (MAST) CTA	5043	3947	7396	7661	8187	8205	8385	8570
H56	Adv Decision Arch Collab Tech Alliance (CTA)	5945	6097	5550	5957	6061	6259	6413	6571
H59	UNIV CENTERS OF EXCEL	1787	1927	2877	3412	3479	3539	3615	3692
H62	ELECTROMECH/HYPER PHYS	5551	6139	6018	6154	6542	6672	6819	6969
H64	MATERIALS CENTER	2161	2669	2745	2823	2884	2941	3006	3072
H65	MICROELECTRONICS CTR	662	1053						
H73	NAT AUTO CENTER	4468	2848	2893	2949	2980	3002	3068	3136
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	6886	7330	7484	7698	7918	8079	8259	8443
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	4413	3971						
J12	NANOTECHNOLOGY	9520	9557	9897	10097	10432	10755	11105	11260
J13	UNIVERSITY AND INDUSTRY INITIATIVES (CA)	17144	13945						
J14	ECYBERMISSION	4609	4973	5118	5245	5359	5466	5586	5709
J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	4791	6132	7184	7916	8278	8278	8460	8646
J16	NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE		2053	2977	2995				
J17	VERTICAL LIFT RESEARCH CENTER OF			1984	2032	2077	2119	2166	2213

	EXCELLENCE								
J19	NAT'L AUTO CENTER (CA)		1286						

A. Mission Description and Budget Item Justification: A significant portion of the work performed within this program directly supports Future Force requirements by providing research that supports enabling technologies for Future Force capabilities. Broadly, the work in this project falls into three categories: Collaborative Technology Alliances (CTAs), University Centers of Excellence (COE), and paradigm-shifting centers - University-Affiliated Research Centers (UARCs). The Army has formed CTAs to leverage large investments by the commercial sector in basic research areas that are of great interest to the Army. CTAs involve partnerships between industry, academia, and the Army Research Laboratory to incorporate the practicality of industry, the expansion of the boundaries of knowledge from universities, and Army scientist to shape mature and transition technology. CTAs have been competitively established in the areas of Advanced Sensors, Advanced Decision Architecture, Communications and Networks, Power and Energy, and Robotics. This program element (PE) includes the Army's COE, which focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs, such as rotorcraft, automotive, microelectronics, materials, and information sciences. COEs couple state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in information sciences, materials science, electronics, automotive, and rotary wing technology. Also included is eCYBERMISSION, the Army's national web-based competition to stimulate interest in science, math, and technology among middle and high school students. This program element also includes the four Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary effort. The Institute of Advanced Technology funds basic research in electromagnetics and hypervelocity physics. The Institute for Soldier Nanotechnologies focuses on Soldier protection by emphasizing revolutionary materials research for advanced Soldier protection and survivability. The Institute for Collaborative Biotechnologies, focusing on enabling network centric-technologies, will broaden the Army's use of biotechnology for the development of bio-inspired materials, sensors, and information processing. The Institute for Creative Technologies is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for training and simulation. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. Historically Black Colleges and Universities and Minority Institution (HBCU/MI) Centers of Excellence address critical research areas for Army Transformation. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this PE is managed by: the Army Research Lab (ARL); the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC); the Simulation and Training Technology Center (STTC); and the US Army Research Institute for the Behavioral and Social Sciences (ARI).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601104A - University and Industry Research Centers**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	100498	86416	90338	93203
Current BES/President's Budget (FY 2008/2009)	96175	95748	84034	87814
Total Adjustments	-4323	9332	-6304	-5389
Congressional Program Reductions		-5366		
Congressional Rescissions				
Congressional Increases		15400		
Reprogrammings	-4323	-702		
SBIR/STTR Transfer				
Adjustments to Budget Years			-6304	-5389

Fifteen FY07 congressional adds totaling $14761 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1532) Ctr for Ferroelectric Electr Photonic Nanodevices
($1293) Nanotubes Optimized for Ltwgt Exceptional Strength
($958) Rapid Deployable Visulaization forTrng & Sim
($959) Center for Advanced Sensors
($959) Ctr for Information Assurance and Cyberwarfare
($1246) National Security Network Testbed
($1245) Ctr for Education-Nanoscience & Nanotechnology Res
($959) National Center for Infotonics
($959) Army Corrosian Control: Inhibition & Detection
($288) Florida Collaborative Dev of Adv Materials for Def
($959) Integrated Sys in Sensing, Imaging & Comms Rsch
($959) Nanosensor Stagegate Accelerator - Benet Labs
($240) Transparent Nanocomposite Armor
($959) Western Hemisphere Security Analysis Ctr (WHSAC)
($1246) Automotive Research

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H04**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	4800	2598	2660	2732	2790	2847	2910	2974

A. Mission Description and Budget Item Justification: Centers of Excellence have proven effective in harnessing a critical mass of university research expertise and focusing their intellectual capabilities on Army unique science and technology problems. The objective is to transition advances resulting from basic research to technology demonstration as rapidly as possible. This project takes that approach one step further by partnering the university researchers at Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) with Army Training and Doctrine Command (TRADOC) Battle Labs to gain first hand perspective of the end-user's needs. Through these centers, the Army user begins the collaboration with university researchers from the outset of the research. These Centers of Excellence will join with Army and industrial partners to accelerate the transition from research phase to actual technology demonstration. In addition, these Centers of Excellence will recruit, educate, and train outstanding students and post doctoral researchers in science and technology areas relevant to Army Transformation. This project was previously funded in PE 061104A Project H59 and is a restructuring of ongoing research into a distinct project for visibility and management. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work on this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
The HBCU/MI Centers of Excellence for Battlefield Capability Enhancements are: Tuskegee University, research on flexible extremities protection; NCA&T State University, research on flexible displays and predictive modeling of group situational awareness; Tennessee State University, research on sensor fusion; and Prairie View A&M University, research on Beyond-Line-of-Sight Lethality. Collaborations with TRADOC Battle Labs will help accelerate technology transitions to the battlefield. In FY06, devised promising stab resistance in new fabric composites; completed basic computational structure for predicting sensemaking (cognitive process experiments and collaborative decision making); showed growth of semiconductor materials on flexible substrates at room temperature; devised target-tracking using multiple sensors; devised a wireless tactical network. In FY07, devise improved stab resistance using new fabric designs; refine computer-based experimental sensemaking model test beds; continue investigation of semiconductor materials growth on flexible substrates; devise multi-modal model sensor networks; devise simulation test bed to determine network performance. In FY08, will refine fabric designs with new testing strategies; will validate sensemaking models with test command groups; will characterize semiconductor materials on flexible substrates for optical properties; will show use of multi-modal sensor network in urban terrain; will refine wireless network protocols using simulation test bed. In FY09, will devise enhanced protection capability of final fabric designs; will deliver deployable decision support programs for test command groups; will design and fabricate hybrid semiconductor devices on flexible substrates and evaluate environmental stability; will show full data-fusion for large-scale sensor networks; will show protocols for wireless sensor network.	2405	2525	2660	2732
This congressional add supports basic research at Lincoln University, a Historically Black University, for multiple years with no additional funding required to complete this project.	2395			
Small Business Innovative Research/Small Business Technology Transfer Programs		73		

Total	4800	2598	2660	2732

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H05**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	6541	7039	7168	7319	7478	7627	7795	7966

A. Mission Description and Budget Item Justification: This project supports the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center led by the University of California-Santa Barbara, and two major supporting partners, the California Institute of Technology and the Massachusetts Institute of Technology. The ICB is the Army's primary conduit for leveraging biotechnology for: 1) advanced sensors; 2) new electronic, magnetic, and optical materials; and 3) information processing and bioinspired network analysis. The objective is to perform sustained multidisciplinary basic research supporting technology to provide the Army with biomolecular sensor platforms with unprecedented sensitivity, reliability, and durability; higher-order arrays of functional electronic and optoelectronic components capable of self-assembly and with multi-functions; and new biological means to process, integrate, and network information. These sensor platforms will incorporate proteomics (large scale study of proteins) technology, DNA sequence identification and detection tools, and the capability for recognition of viral pathogens. A second ICB objective is to educate and train outstanding students and post doctoral researchers in revolutionary areas of science to support Army Transformation. The ICB has many industrial partners, such as IBM and SAIC, and has strong collaborations with Argonne, Lawrence Berkley, Lawrence Livermore, Los Alamos, Oak Ridge, and Sandia National Laboratories, the Army's Institute for Soldier Nanotechnologies, the Institute for Creative Technologies, and Army Medical Research and Materiel Command laboratories. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Institute for Collaborative Biotechnologies: In FY06 formulated fastest available method for generating binding peptides for Army biosensing, diagnostics, and therapeutics applications; devised the collective optical response of multi-chromophore macromolecules and DNA-specific electrode surfaces and microfabrication for the detection and identification of multiple DNA sequences for threat detection, biometrics, and Soldier status-analysis; adapted unique proteomics technology and diagnostic markers into microfluidics-based modified proteomics libraries for advanced analysis in early detection of human pathology; established the roles of interfaces for potential use of biological plus non-biological hybrid components in advanced electronic and photonic devices. In FY07, provide foundation for incorporation of deterministic and stochastic dynamic models from biological systems, improving engineered Army network robustness; use the power and selectivity of biomolecular recognition and accelerated genetic selection and rapid evolution for elaboration of growth-directing peptides for specific crystalline semiconductor materials and electrode bridges with potential for electronic device application; enable controlled surface functionalization and ligand display on, and integration into, materials for application in sensors, multi-functional materials, and device assembly; and devise genetically engineered microbial systems that efficiently incorporate unnatural amino acids into proteins for unique materials for the Army. In FY08, will establish biologically based development path toward flexible high-efficiency batteries and new high-efficiency solar energy materials; provide a means to greatly enhance sensitivity in detection of viral pathogens; and enable electronic detection of DNA. In FY09, will define a biocatalytically derived route to low-cost fuel and fuel-cell feedstock; characterize and further develop microfluidic chip-based bioseparation technology.	6541	6841	7168	7319
Small Business Innovative Research/Small Business Technology Transfer Programs		198		

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H09**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2406	2598	3066	3630	4367	4457	4590	4626

A. Mission Description and Budget Item Justification: This project conducts basic research in areas that will expand the capabilities of intelligent mobile robotic systems for military applications with a focus on enhanced, innate intelligence, ultimately approaching that of a dog or other intelligent animal, to permit unmanned systems to function as productive members of a military team. Research is conducted in machine perception, including the exploration of sensor phenomenology, and the maturation of basic machine vision algorithms enabling future unmanned systems to more fully understand their local environment for enhanced mobility and tactical performance; intelligent control, including maturation of artificial intelligence techniques for robot behaviors permitting future systems to autonomously adapt, and alter their behavior to dynamic tactical situations; and understanding the interaction of humans with machines focusing upon intuitive control by Soldiers that minimizes cognitive burden. The program will conduct both analytic and experimental studies. Research products will be transitioned to the companion applied technology program, PE 0602618A H03, for integration and evaluation in test bed platforms and will form the scientific basis for new technology that will migrate into Army and Joint advanced and system development programs to provide highly capable unmanned systems for the Future Force. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Robotics Collaborative Technology Alliance: Explore new opportunities to enable revolutionary, autonomous, highly mobile systems for the Future Force. Research focuses on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. In FY06, explored multiple methodologies for detecting, classifying, tracking, and projecting potential trajectories of moving objects, including humans, from a moving platform and created the basis for evaluating likely courses of action based upon limited information as applied to local path planning for unmanned vehicles in dynamic environments. In FY07, extend perception research to explore algorithms that are specialized for application to urban environments and incorporate contextual information into planning processes to create a more natural (human-like) response to dynamic changes in the tactical environment. In FY08, will explore methodologies to permit unmanned systems to perform as co-combatants, examining approaches for real-time evaluation of multiple possible adversarial responses, each possessing differing levels of likelihood based upon considerations such as terrain, and a dynamic tactical environment that also includes friendly and non-combatant forces; expand the range of perception algorithms available for classification of structures found in the urban environment and explore methods to fuse detections from individual sensor modalities and/or algorithmic approaches. In FY09, will focus upon techniques for fusion of the key perception algorithms to enable an unmanned vehicle to maneuver with a high degree of autonomy in urban environments; evaluate the performance of both perception, and behavior algorithms in varied tactical environments.	2406	2525	3066	3630
Small Business Innovative Research/Small Business Technology Transfer Programs		73		
Total	2406	2598	3066	3630

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H50**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H50	Comms & Networks Collab Tech Alliance (CTA)	7139	7509	7032	7198	7489	7572	7655	7812

A. Mission Description and Budget Item Justification: This project supports a competitively selected university/industry consortium, the Communication and Networks Collaborative Technology Alliance (CTA) that was formed to leverage commercial research investments to provide solutions for the Army's requirements for robust, survivable, and highly mobile wireless communications networks. The Future Force has a requirement for state-of-the-art wireless mobile communications networks for command-on-the-move. The objectives include designing communications systems for survivable wireless mobile networks; providing signal processing for communications-on-the-move; secure jam-resistant communications; and tactical information protection. The CTA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as the use of state-of -the-art facilities and equipment at the participating organizations. This CTA accelerates the transition of communications and networks technology to program element (PE) 0602783A (Computer and Software Technology). The results of this work will significantly affect Future Force communications/networking formulation efforts. This program will be re-focused to more strongly emphasize Information Assurance and Network Science as defined by the December 2005 National Research Council Board on Army Science and Technology study. When the International Technology Alliance on Network and Information Sciences (PE/project 0601104/J15) is established in 2006, joint planning of the research programs will prevent redundancies and leverage accomplishments from both programs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Survivable Wireless Mobile Networks: Perform research in dynamically self-configuring wireless network technologies that enables secure, scaleable, energy-efficient, and reliable communications for command on-the-move. Develop techniques to model, design, analyze, predict, and control the performance of mobile ad hoc networks. In FY06, devised and validated auto configuration protocols that allow mobile networks to adapt to dynamic conditions. In FY07, conduct analytical and experimental studies validating dynamic and survivable resource control to enable mobile networks to predictably exploit distributed network infrastructures. Devise and validate adaptive distributed control of physical, medium-access, and network layers based on statistical inferencing to adapt communications parameters for improved performance. In FY08, will devise formal models, abstractions, metrics, and validation techniques for understanding the behavior of large scale military mobile ad hoc networks. Will design techniques that combine social networking and network structure control functions in real time to dramatically increase the level of resource utilization in keeping with the stated intentions (outcomes) of a particular military objective. In FY09, will design networking techniques for sensing the networking operating environment, identifying the best networking functional components, and dynamically composing protocols for superior performance.	2743	2812	2751	2804
Signal Processing for Communication-on-the-Move: Perform research in signal processing techniques to enable reliable low-power multimedia communications among highly mobile users under adverse wireless conditions. In FY06, conducted analytic and experimental studies of Multi-Input, Multi-Output systems that are spectrally-efficient and robust for non-line-of-sight mobile communications. In FY07, conduct analytical and experimental studies of signal processing aided medium access control algorithms that improves communications performance while on-the-move. In FY08, will design and validate multi-input multi-output multi-carrier waveforms	1665	1701	1624	1651

that exploit non-contiguous spectrum during mobile operations. In FY09, will design optimal channel-adaptive distributed multiple access techniques to provide high capacity, interference-robust, multiple access networks for communications-on-the-move.				
Secure Jam-Resistant Communication: Perform research in secure, jam-resistant, multi-user communications effective in noisy/cluttered and hostile wireless environments enabling low probability of detection/intercept. In FY06, conducted analytical and experimental studies of frequency-hopping systems that enable robust and mobile anti-jam effectiveness. In FY07, devise and study sensor array processing and interference techniques that enable adaptive antennas for improved interference rejection and spectrum reuse. In FY08, will devise low power adaptive medium access control algorithms that are energy-efficient and support duty-cycling to extend the life of sensor networks. In FY09, will design signal separation techniques to mitigate packet collisions and improve signal detection for improved network performance.	1263	1261	1075	1054
Tactical Information Protection: Perform research in scaleable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY06, conducted analytical and experimental studies of intrusion detection algorithms that are effective in mobile ad hoc networks with no concentration points where traffic can be analyzed. In FY07, devise and study security schemes for distributed servers supporting dynamic network infrastructures. Design energy-efficient and low-latency key management and trust algorithms to enable flexibility in group access control without reliance on strategic security services. In FY08, will design and evaluate formal-methods-based protocol specification intrusion detection techniques on mobile ad hoc networking protocols. In FY09, will design resilient clustering algorithms to provide a dynamic detection hierarchy to support detection and localization of attackers under mobile conditions.	1468	1523	1582	1689
Small Business Innovative Research/Small Business Technology Transfer Programs		212		
Total	7139	7509	7032	7198

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H53**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H53 ADV DIS INTR SIM RSCH	2309	2077	1985	1996	2000	2000	2072	2118

A. Mission Description and Budget Item Justification: This project supports Army critical research at the Army High Performance Computing Research Center (AHPCRC). Research at the AHPCRC is focused on the Light Combat Systems Survivability (LCSS), including: structural response of armored vehicles to perforating and non-perforating projectiles, investigating more efficient gun projectile and missile propulsion systems, evaluating materials suitable for armor/anti-armor applications, defense from chemical/biological agents, signature modeling, and associated enabling technologies. This project also supports the Robotics Collaborative Technology Alliance which explores new opportunities to enable revolutionary autonomous mobility of unmanned systems for the Future Force. This research is an integral part of the larger Army Robotics Program and feeds technology into PE 0602618, project H03 (Robotics Technology). The project will also address research focusing on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. Work in this project is performed extramurally by the Army Research Laboratory.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Perform research at the Army High Performance Computing Research Center (AHPCRC) requiring computationally intensive algorithms in the areas of projectile-target interaction, signature modeling, chemical/biological defense, nano-science and nano-mechanics, and scientific visualization enabling technologies that support the Future Force transition path. In FY06, integrated software for intrusion detection with Army Center for Intrusion Monitoring codes and validated the software for Army application; implemented new physics-based model to enhance interior ballistics prediction capability for Army application; designed multi-scale nanotechnologies modeling algorithm; implemented new analytical capability for modeling descent and terminal fragmentation of arrow shells. In FY07, incorporate infrastructure to allow for nanoscale optical, magnetic, and biosensors on a deployable chip; explore multi-sensory visualization approaches to better understand and process multivariate data; research algorithms for rigid and elastic multi-body dynamics analyses for air and ground vehicles; investigate new modeling methods for nonlinear computational structural mechanics. In FY08, will explore new interdisciplinary methods to evaluate lightweight combat systems, will implement data mining algorithms to assist different Army applications, will investigate and plan new computational approaches to analyze very large-scale networks for battlefield applications. In FY09, will implement interdisciplinary methods for analysis and evaluation of survivability of lightweight combat systems; will apply data mining algorithms to enhance and correlate Army scientific applications and experiments; will explore new multi-scale computational approaches for assisting micro-systems design.	2000	1650	1985	1996
Perform research that focuses on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. In FY06, explored tracking of moving people from a moving platform in a cluttered environment and trajectory prediction. In FY07, investigate coupling of tracking and trajectory prediction algorithms with dynamic planning algorithms.	309	369		
Small Business Innovative Research/Small Business Technology Transfer Programs		58		
Total	2309	2077	1985	1996

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H54**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H54	Micro-Autonomous Systems (MAST) CTA	5043	3947	7396	7661	8187	8205	8385	8570

A. Mission Description and Budget Item Justification: This project supports two competitively selected industry/university consortia, the Advanced Sensor Collaborative Technology Alliance (CTA) and the Micro Autonomous Systems and Technology (MAST) CTA, that leverage world-class commercial research necessary to address Future Force and Army Transformation needs. The CTAs link a broad range of government technology agencies, as well as industrial and academic partners with the Army Research Lab (ARL). The Advanced Sensors CTA is focused on innovative research in three main technical areas: micro-sensors, electro-optic smart sensors, and advanced radar concepts. Payoff to the warfighter will be advanced sensing technologies to support Future Force requirements. Technical areas addressed under this project include overcoming technical barriers associated with: autonomous calibration and management of micro-sensor networks; multi-domain smart sensors (including multi-spectral infrared focal plane arrays); a novel concept for laser radar (LADAR); multifunctional radar sensors; and sensor modeling and algorithms for automatic target recognition (ATR) through fusion of data from multiple sensors and signal processing. Work in the Advanced Sensors CTA accelerates the transition of technology to program element (PE) 0602120 (Sensors and Electronic Survivability). The MAST CTA will focus on innovative research in four main technical areas related to the coherent and collaborative operation of multiple micro autonomous platforms: microsystem mechanics, processing for autonomous operation, microelectronics, and platform integration. Payoff to the warfighter will be advanced technologies to support Future Force requirements in situational awareness. Both CTAs facilitate the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as to use state-of-the-art facilities and equipment at the participating organizations. The cited works are consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL). In FY08, this project (Advanced Sensors CTA) transitions to Micro Autonomous Systems and Technologies CTA and is restructured to include FY08 and FY09 funding from project J09 of this program element.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
This project has been restructured to increase the emphasis on microsensors and reduce the efforts in both the radar and electro-optics factors. As such, the following deliverables are planned to perform microsensor, electro-optics, and radar research focused on various passive and active sensors, algorithms, low-power signal processing, and autonomous sensor/network management for the unattended sensor network component, resulting in technology transfer and delivery of sensor nodes to applied research. In FY06, validated a 32x32 active imager array on a custom readout circuit, demonstrated a novel, multi-beam all-dielectric lens for phase array antennas, and completed a mathematical framework for decentralized detection, identification, and tracking of vehicles and people across a cluster of nodes. In FY07, fabricate a long wavelength infrared 320x256 gallium antimonide passive imager array, validate a highly robust Low Noise Amplifier Monolithic Microwave Integrated Circuit (MMIC) for use in hostile electromagnetic environments of the electronic battlefield, and experimentally validate autonomous sensor management capability.	5043	3836		
The MAST CTA will focus on innovative research related to the coherent and collaborative operation of multiple micro autonomous platforms to enhance situational awareness. In FY08, the MAST will investigate platform stability and control in high-disturbance environments; bio-inspired, bio-mimetic leg, and wing concepts with integrated sensors and actuators; autonomous and semi-autonomous navigation and control over a network; group cooperative behavior and planning; efficient sensing and information extraction and utilization; constrained information management within a node; distributed signal processing, including low complexity techniques for			7396	7661

distributed multi-modal sensing and fusion, dynamic collaborative processing accounting for sporadic sensing and sensor management, lightweight robust and possibly asymmetric networking, integrated cross-layer communications and network design, architecture analysis to understand fundamental limits, system modeling and simulation, and design tools capable of balancing and optimizing trade-offs in a microsystem architecture, technologies required for the coherent and collaborative operation of multiple micro autonomous platforms. Investigations may include vortex-dominated unsteady aerodynamics of flapping wings at low Reynolds numbers, high-force high-bandwidth large-displacement linear actuators, and autonomous and semi-autonomous navigation and control over a network. In FY09, will mature technologies required for the coherent and collaborative operation of multiple micro autonomous platforms. Investigations may include communications and networking, synthesis, and development of three-dimensional materials and circuit architectures, development of smart multifunctional structures, and materials, low power devices, hybrid power systems and power management, microsystems architectures modeling and simulation, and functional packaging.				
Small Business Innovative Research/Small Business Technology Transfer Programs		111		
Total	5043	3947	7396	7661

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H56**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H56	Adv Decision Arch Collab Tech Alliance (CTA)	5945	6097	5550	5957	6061	6259	6413	6571

A. Mission Description and Budget Item Justification: This project supports a competitively selected industry/university consortium, the Advanced Decision Architecture Collaborative Technology Alliance (CTA), for the purpose of leveraging world-class commercial research in support of the Future Force and Army transformation needs. The Future Force will require state-of-the-art user-centered decision support technologies to include user-interface concepts, design practices, and principles. These technologies will provide for real-time situational awareness, distributed commander-staff-subordinate collaboration and planning, and execution monitoring in high-tempo, high-stress battlefield environments at speeds that permit the commander and his staff to operate inside the enemy's decision cycle. This project will conduct an intensive and accelerated program to formulate, validate, and transition basic research to provide solutions for the many requirements for understanding situational awareness, expert decision making, team collaboration, the ability to display information in a way that facilitates knowledge assimilation on the battlefield, and visualization and decision support architectures. Research is conducted in four areas: cognitive process modeling and measurement, analytical tools for collaborative planning and execution, user adaptable interfaces, and auto-adaptive information presentation. The technical barriers associated with this project are: human-computer interface in an information rich environment; display configuration; real time visualization; information presentation; and control coupling. The CTA also facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as the use of state-of-the-art facilities and equipment at the participating organizations. This CTA accelerates the transition of advanced decision architecture technology to PE 0602716 (Human Factors Engineering Technology) and program element (PE) 0602783 (Computer and Software Technology). This program will be re-focused to emphasize individual Soldier, squad, and platoon level tools and information and knowledge fusion. Research partnerships will be established with the Institute for Creative Technology (PE/project 0601104/J08) and the Flexible Display Center (PE/project 0602705/H17) to establish collaborative and synergistic research programs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers): In FY06, investigated applicability of social network models of commander and staff interactions for organizational design. In FY07, validate decision architecture for information fusion, which uses diagrammatic reasoning as an aid to evaluate the commander's preferred course of action. In FY08, will extend and improve a system for the automatic generation of Cognitive Models of Situation Awareness (CMSA). In FY09, will validate software agent architecture for enhancing the performance of human teams using advanced artificial intelligence techniques including context-sensitive information sharing, automated development of shared situation awareness and recognition-primed decision support, a naturalistic decision making (NDM) technique used by experienced decision makers to quickly scan an array of displays or information and "instantly" know the best course of action to pursue.	1718	1420	1320	1400
Analytical tools for collaborative planning and execution: Create tools that effectively support teams in coordinating and collaborating to achieve mission success across the spectrum of operations. In FY06, designed and conducted experiments to examine parametric variations on decision-making processes and procedures and studied the use of advanced digital tools for continuous planning in a distributed environment. In FY07, complete prototype decision-making architecture for collaboration and visualization test bed. In FY08, will provide tools and techniques to foster better adaptive learning, expert decision-making, and teamwork. In FY09, will devise	1408	1408	1208	1343

theoretical foundations and empirical findings on the design of collaborative systems to make Soldiers more effective as sensors in the Brigade and Below Battlefield Awareness Network environment and to enhance Soldier-automation collaboration.				
User-adaptive interfaces: Explore ideas, frameworks, and technologies that assist the Soldier in understanding, problem solving, planning, and decision-making. In FY06, integrated advanced haptic (touch) displays into a multi-modal test bed and evaluated effect on Soldier performance. In FY07, integrate capability for multinational, multilingual communication in stability and support test bed. In FY08, will investigate interface technologies to fuse and visualize sensed information (persistent surveillance) as relevant tactical events to improve Commander's real time situational awareness. In FY09, will validate functional model of the capabilities of new sensor/network technologies as they could contribute to perceptual awareness including concepts such as trust.	1646	1724	1708	1902
Auto-adaptive information presentation: Investigate how to make autonomous machines team players with their human partners or supervisors in warfighting operations. In FY06, validated test bed for multi-modal information exchange and dynamic adaptation. In FY07, extend software agent systems to provide an agile computing infrastructure for brigade combat teams. In FY08, will experimentally test an agile computing infrastructure integrated with agent-based policy and domain services to enable efficient use of scarce computing and network resources and coordination of human-robot teams in realistic Army future combat system scenarios. In FY09, will devise a distributed system for real-time target tracking of multiple entities in an area under surveillance exploiting a reasoning-based approach to include diagrammatic reasoning, domain knowledge, and algorithmic solutions.	1173	1374	1314	1312
Small Business Innovative Research/Small Business Technology Transfer Programs		171		
Total	5945	6097	5550	5957

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H59**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H59 UNIV CENTERS OF EXCEL	1787	1927	2877	3412	3479	3539	3615	3692

A. Mission Description and Budget Item Justification: Army Centers of Excellence (COE) couple state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of scientists and engineers who can contribute to Army Transformation. The Rotorcraft Center of Excellence is the only program funded in this project in FY06 and FY07. This COE supports Army Transformation by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. Beginning in FY08, this project will fund the International Technology Centers (ITCs) and the Foreign Technology (and Science) Assessment Support (FTAS) program. The nine ITCs located in Australia, the United Kingdom, Canada, France, Germany, Japan, Chile, Argentina, and Singapore support the Army's goals of providing the best technology in the world to our warfighters by leveraging the Science and Technology (S&T) investments of our international partners. The ITCs perform identification and evaluation of international technology programs to assess their potential impact on the Army's S&T investment strategy. ITC "technology finds" are submitted as technology information papers (TIPs) to various Army S&T customers including the Army Research Laboratory (ARL), the Research Development and Engineering Centers (RDECs) of the Research Development and Engineering Command (RDECOM), RDECOM technology Integrated Process Teams, the Rapid Equipping Force (REF), and others for evaluation and consideration for further research and development. The ITC TIPs also serve as input into the international section of the Army S&T Master Plan. The FTAS program builds upon the TIPs submitted by the ITCs. In some cases the TIP is truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. In such cases, the FTAS program can provide initial resources (seed money) to fund basic research in these technology areas identified by the TIPs as having potential relevance to the Army's S&T plan. The research will provide information useful in making an early assessment of the technology's potential contributions to the Army's S&T strategy. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL) and Aviation and Missile Research, Development, and Engineering Center (AMRDEC).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
International Technology Centers (ITC)/Foreign Technology (and Science) Assessment Support (FTAS): In FYs 08 and 09, the ITCs will complete the developement of their international technology search process by utilizing technology roadmaps provided by the Research, Development, and Engineer Command's (REDCOM) technology Integrate Process Teams (IPTs) to focus on critical technology capability gaps. The ITCs will further refine their country-specific technology search strategies based upon the analysis of foreign Science and Technology (S&T) investment patterns in areas of technology relevant to the US Army. Technology search efforts will then focus on those countries and in those areas of technology having the greatest potential benefit to the US Army. In FYs 08 and 09, FTAS will evaluate progress on the initial program investments from FYs 06 and 07, and solicit new technology proposals for review and selection. The program will solicit technology projects focusing on the maturation of counter terrorism technologies, providing enhanced force protection, enhanced medical life saving projects and providing enhanced Soldier capabilities. A review of the lessons learned from the initial round of FTAS investments, including the selection and review process, will be utilized to improve the program. Prior to FY08, the ITC and FTAS efforts were funded in PE 0601102A, project H57.			2877	3412
Rotorcraft Centers of Excellence (RCOE): In FY06, the RCOE refocused efforts to address vertical lift technologies which will provide major cost reductions in heavy lift vehicles and developed active flow control concepts for improving rotorcraft performance and reducing	1787	1873		

noise and vibratory loads; investigated advanced adaptive flight control systems and autonomous control functionality; investigated low Reynolds number aerodynamics for small Unmanned Air Vehicle (UAV) design analysis and developed advanced concepts for rotorcraft UAV systems. In FY07, the RCOE are developing structures and materials concepts for lightweight composite rotor blades; investigating next generation carbon-nanotube/carbon-fiber composites for mechanical properties enhancement and real-time structural health monitoring; studying, experimentally and analytically, aerodynamic characteristics of active flaps and microflaps for reducing rotor vibration, power, and noise; and developing performance improvements in ducted-fan systems for vertical lift systems and UAVs. For FYs 08-09, this effort will be restructured into PE 0601104A project J17 for added focus and management oversight.				
Small Business Innovative Research/Small Business Technology Transfer Programs		54		
Total	1787	1927	2877	3412

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H62**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H62 ELECTROMECH/HYPER PHYS	5551	6139	6018	6154	6542	6672	6819	6969

A. Mission Description and Budget Item Justification: This project funds a University Affiliated Research Center, the Institute for Advanced Technology (IAT) at the University of Texas, to conduct basic research in electromechanics and hypervelocity physics in support of electromagnetic (EM) guns. Of particular interest is EM power, EM launchers, EM integrated launch packages, and hypervelocity terminal ballistics. Advanced computational models are devised and/or applied to solve complex problems in each of these areas. In keeping with the Army EM Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power. The sponsored research provides the scientific underpinning for EM gun pulsed power including switching; addresses technical barriers associated with EM gun launcher life; and researches advanced technologies for hypervelocity target defeat. The sum of these focused efforts serves as a catalyst for technological innovation and provides crucial support to the Army technology base for advanced weapon systems development with applications for anti-armor, artillery, air defense, and the Future Force. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is monitored and guided by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Pulsed Power: In FY06, conducted component material experiments, matured a parallel silicon carbide (SiC) switch module, modeled pulsed power, and examined machine synchronization. In FY07, model electromagnetic, mechanical, and thermal properties of candidate EM pulsed power systems and define techniques to increase their efficiency. In FY08, will model and experimentally validate prototype alternate pulsed power systems. In FY09, will provide technology for large-scale solid state converters.	2151	2379	2500	2650
Launch: In FY06, incorporated launcher model into pulsed power model. In FY07, show long-life, multi-shot EM launcher operation. In FY08, will examine advanced materials for launcher components. In FY09, will examine thermal management of EM launchers.	1400	1587	1618	1700
Electromagnetic Lethality: In FY06, tested complete novel kinetic energy penetrator (NKEP) and incorporated NKEP into half-scale launch package for EM launch. In FY07, establish bounds on launch package parasitic mass; design, fabricate, and test full scale in-flight deployment mechanisms for second generation novel kinetic energy penetrators. In FY08, will measure material properties under short duration electrodynamic and structural loads; will examine the target interaction physics of reactive material during hypervelocity impact. In FY09, will complete and validate numerical model of armature physics including gouging and transition; will examine coupled high density/reactive materials during target interaction at hypervelocity.	2000	2000	1900	1804
Small Business Innovative Research/Small Business Technology Transfer Programs		173		
Total	5551	6139	6018	6154

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H64**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H64 MATERIALS CENTER	2161	2669	2745	2823	2884	2941	3006	3072

A. Mission Description and Budget Item Justification: This project concentrates scientific resources on materials research for lightweight vehicle protection and is executed through Cooperative Research Agreements (CRAs). The effort funds collaborative research in three Materials Science and Engineering Research Areas (MSERAs): (1) Composite Materials Research; (2) Advanced Metals and Ceramics Research; and (3) Polymer Materials Research. Each MSERA pursues thematic research thrusts that address topics pertinent to lightweight vehicle protection and that are aligned with the Army's strategic materials research vision enabling long-term synergistic collaboration between the Army Research Laboratory (ARL) scientists and university researchers. The Materials Cooperative Research Agreements provide for mutual exchange of personnel and sharing of research facilities with the University of Delaware, Johns Hopkins University, Rutgers University, Drexel University, and Virginia Tech. Lightweight, multi-functional composites, advanced armor ceramics, dynamic response of metals, protective polymer, and hybrid systems are emphasized. This project is closely coordinated with ARL in-house materials research projects (program element (PE) 0601102A, project H42) to promote effective and efficient transfer of fundamental scientific research addressing lightweight protective material requirements for the Future Force. The center accelerates the transition of technology to PE 0602105A (Materials Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, characterized fundamental behavior of multifunctional composite materials; devised materials concepts that utilize self-assembly methods to produce polymers, fibers, or coatings; and validated physics based models to predict the effects of microstructure on inorganic materials systems. In FY07, devise appropriate physics based models describing the attributes of multifunctional materials; determine the fundamental response of protective polymer based materials; devise new inorganic materials that incorporate microstructures designed for specific armor related properties. In FY08, will validate models for multifunctional composite attributes and show multifunctional capabilities in single composite material; devise schemes for synthesis of protective polymers with enhanced energy absorption; identify key materials parameters for the improved performance of metal matrix nanocomposite materials. In FY09, will utilize multifunctional composites to validate potential composite weight reductions; characterize and quantify performance of newly synthesized energy absorbing polymers; and validate effects of armor ceramic processing and materials selection on mechanical properties.	2161	2594	2745	2823
Small Business Innovative Research		75		
Total	2161	2669	2745	2823

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H73**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H73 NAT AUTO CENTER	4468	2848	2893	2949	2980	3002	3068	3136

A. Mission Description and Budget Item Justification: The Center of Excellence for Automotive Research is a key element of the basic research component of the National Automotive Center (NAC), a business group within the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC). The Center is an innovative university/industry/government consortium leveraging commercial technology for potential application in Army vehicle systems through ongoing and new programs in automotive research, resulting in significant cost savings while maximizing technological achievement. The goal of this project is to significantly enhance the Army's transformation to the Future Force by the application of novel, high payoff technologies that can be phased in as improvements to vehicles over the next several decades. The research performed in this project contributes to formulating and establishing the basic scientific and engineering principles for these technologies. Efforts are fully coordinated and complementary to those performed by the NAC and TARDEC under program element (PE) 0602601A (Combat Vehicle and Automotive Technology). Selected university partners include: University of Michigan, University of Wisconsin, Wayne State University, University of Alaska, University of Tennessee, and Clemson University. Key industry partners include all major US automotive manufacturers and suppliers. The Automotive Research Center (ARC) formulates and evaluates advanced automotive technologies and advances state-of-the-art modeling and simulation for the Army's future vehicular platforms. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by TARDEC, Warren, MI. FY05 Total for this R2 does not match FY07 President's Budget due to administrative error which excluded one congressional add.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Automotive Research Center (ARC): In FY06, formulated and analyzed modeling and simulation tools relating to systems engineering of advanced and alternative energy powered ground vehicles for improved vehicle fuel economy, reduced visual signature, reduced pollutant emissions through the use of advanced diesel and hybrid power trains, and investigated applications of fuel cell auxiliary power units and lightweight material structures; evaluated new concepts, hybrid architectures, component designs, and control strategies for duty cycles representing realistic missions of medium and large trucks, including off-road use of tactical trucks with the human in the loop. In FY07, evaluate and analyze models suitable for ground vehicle design decisions relative to vehicle reliability, reliability based design optimization, high mobility and fuel economy, high power density propulsion, thermal management and parasitic losses, advanced control, robust modeling, and validation of vehicle systems. In FY08, will refine and optimize computational models for ground vehicle characteristics including: fuel economy, acceleration, survivability, reliability, and cost effectiveness. Also in FY08, will perform unique advanced experimental validation of optimized models to assure proper predictions relative to actual real-world conditions. In FY09, will extend the applicability of the advanced models to future Army ground vehicle requirements in areas such as: elevated temperature and increased terrain severity, enhanced survivability, ultra-reliability, and general new global embedded constraints. Also during FY09, will perform new extended experimental model validations of these broadened areas of Army ground vehicle applicability, using unique and advanced instrumentation and efficient state-of-the-art data analysis procedures.	2794	2771	2893	2949
University Based Automotive Research: This one year congressional add continued development of modeling and simulation tools for military ground vehicles. No additional funds are required to complete this project.	1674			
Small Business Innovative Research/Small Business Technology Transfer Programs		77		

Total	4468	2848	2893	2949

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J08**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J08 INSTITUTE FOR CREATIVE TECHNOLOGY	6886	7330	7484	7698	7918	8079	8259	8443

A. Mission Description and Budget Item Justification: This project supports simulation and training technology research at the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. The ICT was established to support Army training and readiness through research into simulation and training technology for applications such as mission rehearsal, leadership development, and distance learning. The ICT actively engages industry (multimedia, location-based simulation, interactive gaming) to exploit dual-use technology and serves as a means for the military to learn about, benefit from, and facilitate the transfer of applicable entertainment technologies into military systems. The ICT also works with creative talent from the entertainment industry to adapt concepts of story and character to increase the degree of participant immersion in synthetic environments and to improve the realism and usefulness of these experiences. Creating a true synthesis of the creativity, technology, and capability of the industry and the R&D community is revolutionizing military training and mission rehearsal by making it more effective in terms of cost, time, range of experiences that can be trained or rehearsed, and the quality of the result. This project accomplishes this by performing basic research in modeling and simulation in accordance with the core competencies for the ICT University Affiliated Research Center (UARC). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Conduct basic research in immersive environments, to include virtual humans, three dimensional (3D) sound and visual media, to achieve more efficient and affordable training, modeling, and simulation solutions. Research includes investigation of techniques and methods to address the rapid development of synthetic environments that can be used for mission rehearsal and training of military operations. In FY06, explored the computational hardware and software approaches for representing the immersive environment using holographic imaging techniques. In FY07, investigate the timing, synchronization, and rendering techniques for augmenting the test beds with holographic imagery. In FY08, will create custom, multi-view, holographic display solutions for visualizing command data sets. In FY09, will investigate use of Organic Light Emitting Diodes, nano-technologies, and programmable matter (the creation of rudimentary elements which can be programmed into software for simulation components and innovative visual displays) in mixed reality immersive environments.	2641	2753	2884	2966
Conduct basic research in two significant aspects of immersive environments - graphics and sound. Research will improve computational techniques in graphics for achieving real-time photo-realistic rendering of physical and synthetic environments for training and simulations. Research into auditory aspects of immersion will provide the sound stimulus for increasing the realism for military training and simulation devices. In FY06, explored multi-view object and imaging techniques. Optimized audio engine performance and integrated with several projects. Investigated methods of harmonic warping of ambient sounds to create an "invisible" auditory score. Developed capability to capture moving or still images of objects or people and relight them so they can be seamlessly embedded in arbitrary environments. In FY07, investigate the concept of generalized reciprocity as it relates to how objects transform incident illumination into reflected light. Examine perceptual cues needed to produce 3D audio via hybrid headphone-loudspeaker techniques. Extend harmonic warping of ambient sounds to use beat tracking techniques to ensure smooth transitions of effects. In FY08, will	1545	1579	1674	1722

implement hybrid 3D audio system to create perception of auditory depth in mixed reality environments. Will develop facial and body animation techniques that can capture a person and then re-light and re-animate him or her in new environments. In FY09, will explore concepts for facial and body animation controlled by avatars in real time and investigate methods for development of virtual speakers in immersive environments.				
Techniques and human - virtual human interaction. In FY06, investigated an intelligent agent architecture concept that accounts for the emotional models, cultural/ethnic impact on verbal and non-verbal communication, synchronized verbal communication conceptual framework for intelligent agents to enable adaptation of the environment based on human and virtual human interactions. In FY07, explore and conduct research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness. In FY08, will investigate techniques for appropriate modeling and social schema for avatar based crowd behaviors. In FY09, will assess adequacy of virtual human models against models of human behavior and use feedback to guide further research. Develop tools and techniques to speed creation and adaptation of virtual humans.	2700	2792	2926	3010
Small Business Innovative Research/Small Business Technology Transfer Programs		206		
Total	6886	7330	7484	7698

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J12**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J12 NANOTECHNOLOGY	9520	9557	9897	10097	10432	10755	11105	11260

A. Mission Description and Budget Item Justification: This project supports sustained multidisciplinary nanotechnology research for the Soldier at the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN emphasizes revolutionary materials research for advanced Soldier protection and survivability. The ISN works in close collaboration with several major industrial partners including Raytheon and DuPont, the Army Research Laboratory (ARL), the Army's Natick Soldier Center (NSC), and other Army Research Development and Engineering Command (RDECOM) centers in pursuit of its goals. The institute is designated as a University Affiliated Research Center (UARC) to support the Army Future Force Warfighter through research to devise nanotechnology-based solutions for the Soldier. This research emphasizes revolutionary materials research toward an advanced uniform concept. The future uniform will integrate a wide range of functionality, including ballistic protection, responsive passive cooling and insulating, screening of chemical and biological agents, biomedical monitoring, performance enhancement, and extremities protection. The objective is to lighten the Soldier's load through system integration and multifunctional devices while increasing survivability. The new technologies will be compatible with other Soldier requirements, including Soldier performance, limited power generation, integrated sensors, communication and display technologies, weapons systems, and expected extremes of temperature, humidity, storage lifetimes, damage, and spoilage. The work cited is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Lab (ARL). .

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Conduct research in Light-weight, Multifunctional Nanostructured Fibers and Materials. In FY06, the ISN theoretically demonstrated the existence of 2-dimensional designs for composite materials that simultaneously have complete photonic and phononic band gaps. Research on initiated Chemical Vapor Deposition (iCVD) showed that a wide range of homopolymers can be conformally deposited in ultra thin coatings (nominally 100 nm) on surfaces. Fundamental experimental and mechanistic modeling studies confirmed that iCVD polymerization occurs at the surface of the material being coated. In FY07, conduct limited fabrication of 2-D and 3-D polymeric structures that have complete band gaps for electromagnetic radiation and elastic waves; assess the light and sound scattering properties of these materials. Use iCVD to impart novel properties to limited numbers of various substrates of interest for EMI shielding and destruction of toxic substances. In FY08, will develop a theory of a new type of "lasing" based on stimulated emission of hypersound in dual band gap (sound and light) composite polymeric structures; identify optimized structures for photon (light) flow control, and measure sound propagation in select materials. In FY09, will use Monte Carlo simulation methods to optimize 2-D and 3-D structural configurations for simultaneous control of light and sound propagation and reflection; fabricate desired structures by interference lithography and test the resulting materials for the directional dependence of energy flow. Will develop mechanically robust iCVD coatings fully compatible with electro-spun mats that provide high surface area and a diversity of substrate materials..	1911	1839	2516	2565
Conduct research in Battle Suit Medicine and Blast and Ballistic Protection. In FY06, achieved new understanding of the anisotropic actuation mechanism in polypyrrole films that will give guidance on processing and design to attain higher electroactive strains. In FY07, conduct initial synthesis of families of flexible backbone/pendant group polymers showing promise for high absorption of mechanical energy. In FY08, will conduct low rate mechanical testing of mechanical energy absorption for promising polymers. In FY09, will	3894	3797	4865	4966

explore relation of molecular structural features to resultant toughness including high strain rate testing.				
- Conduct research on Soldier Survivability and Protection and Nanosystems Integration. In FY06, matured investigation of metal-insulator-semiconductor fibers for sensing temperature and detecting light of different wavelengths. In FY07, conduct initial synthesis and testing of polymers and components for transistors. In FY08, will investigate nano-engineered electronic devices for sensing. In FY09, will explore chemical sensing based upon nanoelectronic building blocks.	3715	3652	2516	2566
Small Business Innovative Research/Small Business Technology Transfer Programs		269		
Total	9520	9557	9897	10097

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J14**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J14 ECYBERMISSION	4609	4973	5118	5245	5359	5466	5586	5709

A. Mission Description and Budget Item Justification: This project supports eCYBERMISSION, a web-based science, math and technology competition designed to stimulate interest and encourage advanced education in these areas among middle and high school students nationwide. The project supports Army Transformation through the sponsorship of a nation-wide education competition that encourages the nation's youth to pursue advanced education and careers in Science, Mathematics, and Engineering, thereby providing a pool of technologically trained potential soldiers and civilians for the Army workforce of tomorrow. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, the Department of Defense Basic Research Plan (BRP), and supports the President's initiative for education. Work in this project is performed extramurally by the Army Research Laboratory (ARL). Note: This project was previously funded in PE 0601104A Project H59 and has been moved to Project J14 for increased visibility and management oversight.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
eCYBERMISSION is a national competition to stimulate interest in science, math and technology in middle and high school students. In FY06, continued full-scale competition to all middle school (grades 6-8) and 9th grade high school students across the country and Department of Defense Educational Activity (DoDEA) schools, with the goal of increased student and teacher participation beyond the results of FY05. In FY07, sustain eCYBERMISSION and continue implementing enhancements as necessary based on previous years' lessons learned. In FY08 and FY09, will continue competition and efforts to increase team participation.	4609	4833	5118	5245
Small Business Innovative Research/Small Business Technology Transfer Programs		140		
Total	4609	4973	5118	5245

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J15**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	4791	6132	7184	7916	8278	8278	8460	8646

A. Mission Description and Budget Item Justification: This project supports a competitively selected United States (US)/United Kingdom (UK) government, university, and industry consortium established to perform fundamental network and information science research in the areas of network theory, system-of-systems security, sensor processing and delivery, and distributed coalition planning and decision making. The focus is on enhancing distributed, secure, and flexible decision-making to improve coalition operations, and developing the scientific foundations for complex and dynamic networked systems-of-systems to support the complex human, social, and technical interactions anticipated in future coalition operations. The US Army Research Laboratory (ARL) and the UK Ministry of Defense (MOD) established a jointly funded and managed US and UK consortium, to be known as an International Technology Alliance (ITA) on Network and Information Sciences in FY06. The goal is fundamental science breakthroughs to enable superior coalition operations. Emphasis is on integration of multiple technical disciplines in an international arena. This program supports the Future Force transition path of the Transformation Campaign Plan (TCP). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Perform fundamental network and information science research for US/UK coalition operations. In FY06, established the US/UK ITA in Network and Information Sciences. Investigated frameworks to describe interactions between network layer and application level data fusion for improved decision-making. Designed and analyzed cognitive medium access control algorithms for spectrum scavenging. Investigated bio-inspired information dissemination protocols for improved adaptability and robustness. In FY07, design and validate interoperability models for disparate networks using cross-layer adaptation methodologies for distributed resource allocation to optimize application specific metrics. Investigate efficient and adaptive security algorithms to enable formation and operation of secure, flexible coalition operation communities-of-interest. Establish initial ontologies for coalition structures and cultural models of planning. In FY08, will investigate mathematical frameworks to model the structure and behavior of wireless networks to establish theoretical limits on capacity, scalability, reliability, and energy-efficiency to understand the performance of command-and-control, sensor, and communication coalition networks. Will design protocols for automated policy negotiations and tools for refining high-level user-specified goals into low-level setting of components in coalition environments. Will devise and validate analytical networked fusion architectures based on semantic information. In FY09, will investigate models, theory, and algorithms for creating self-organizing wireless networks inspired by highly adaptive biological systems. Will investigate cognitive and socio-cultural factors on coalition command processes and coalition networks to enhance situational awareness and decision-making. Will establish and validate analytic frameworks, leading to tradeoffs between sensing, computing, communications, and actuation, for classes of wireless sensor networks.	4791	5960	7184	7916
Small Business Innovative Research/Small Business Technology Transfer Programs		172		
Total	4791	6132	7184	7916

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J16**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J16	NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE		2053	2977	2995				

A. Mission Description and Budget Item Justification: This project conducts basic research in nano and micro technologies to improve the performance and effectiveness of portable electronic equipment for the warfighter. This will be accomplished by reducing power and weight while increasing real-time interactivity of vital information content between the warfighters and their environment. The Center for Nanotechnology and Microelectronics (CNAM) is a university research effort focusing on the development and application of nanotechnology that can be integrated with microelectronic systems while not duplicating existing nanoelectronics research programs. The objective is to accelerate the deployment of nanotechnology for military applications by focusing on applications where nanotechnology complements rather then replaces microelectronics. The research program will concentrate on four technology areas focused on resolving key issues associated with military applications of microelectronics and power electronics. Research thrusts include: 1) Thermal Management - the removal of heat from electronics and power electronics is the primary limit on the performance of small devices. Nanotechnology may improve the performance of thermal management systems by enhancing the cooling properties of materials, interfaces and fluids for microelectronics; 2) Hybrid nano/micro structures and devices - bottom-up self-assembly of nanoscale components onto/into microelectronic platforms can lead to electronic components that integrate nanoscale optical interconnects, produce significantly less waste heat, and integrate on-board sensing; 3) Nanotechnology-enhanced transparent electronic materials - transparent materials can be used for microelectronics, increasing the designers flexibility in integrating microelectronics into other systems; 4) Active Cooling - nanotechnology-based active cooling technology such as high efficiency thermoelectric coolers and nano-enhanced adsorption/desorption cooling can, in theory, cool microelectronics to temperatures below ambient or even to cryogenic temperatures, thus improving performance. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed extramurally by the Army Research Laboratory.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
- Research thrusts include thermal management, hybrid nano/microstructures and devices, nanotechnology-enhanced transparent electronic materials, and active cooling for improved portable warfighter electronic equipment. In FY07, research enhanced materials for thermal management through tailoring the thermal conductivity of materials, fluids and reducing interface resistance; research low power nano-electronics; research nanotechnology-enhanced transparent electronic materials that may augment portable and flexible display technology; research advanced nanotechnology-enhanced cooling including thermoelectric coolers and adsorption/desorption cooling. In FY08, will research specialized thermal management techniques to provide improved cooling of army systems through the fabrication of materials with superior thermal conductivity and functionalized thermal interfaces to enhance heat transfer; will research novel nano-technology based sensors and electronics devices, including potentially lower power systems; will study nanotechnology-enhanced transparent electronic materials that may improve portable and flexible display technology; will investigate advanced nanotechnology-enhanced cooling techniques including thermoelectric and adsorption/desorption cooling. In FY09, will implement thermal management techniques that provide improved thermal conductivity and will study methods to functionalize the thermal interfaces to improve heat transfer; will fabricate novel nano-electronics for low power sensors and systems; will study nanotechnology-enhanced electronic materials that provide superior electrical capabilities; will research advanced nanotechnology-enhanced cooling techniques including		1995	2977	2995

thermoelectric and adsorption/desorption cooling.				
Small Business Innovative Research/Small Business Technology Transfer Programs		58		
Total		2053	2977	2995

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J17**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J17	VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE			1984	2032	2077	2119	2166	2213

A. Mission Description and Budget Item Justification: Vertical Lift Research Center of Excellence couples state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of scientists and engineers who can contribute to Army Transformation. Work will support Army Transformation by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL) and the Aviation and Missile Research, Development, and Engineering Center (AMRDEC).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Vertical Lift Research Center of Excellence - In FY08, will investigate high-lift airfoil concepts for delaying dynamic stall onset and reducing adverse pitching moments; and will develop data fusion and biomimetic materials for rotorcraft health monitoring systems. In FY09, will develop light-weight high-flexibility rotorcraft shafts using flexible matrix composites and active bearing controls; and will develop efficient and affordable joining concepts for high-stiffness, light-weight composites.			1984	2032
Total			1984	2032

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602105A - MATERIALS TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	34423	60102	18614	19029	19400	19673	20066	20518
H7B	Advanced Materials Initiatives (CA)	17252	41487						
H7G	NANOMATERIALS APPLIED RESEARCH	4797	5204	4905	5034	5203	5316	5393	5522
H84	MATERIALS	12374	13411	13709	13995	14197	14357	14673	14996

A. Mission Description and Budget Item Justification: This program element (PE) funds research and evaluation of materials technologies for armor and armaments that will significantly enhance the survivability and lethality of Future Force systems and where feasible, can be exploited to enhance the Current Force. This PE builds on the materials research transitioned from PE 0601102 (Defense Research Sciences) H42 (Materials and Mechanics) project and applies it to specific Army platforms and the individual Soldier. Project H84 is directed toward developing materials technology that contributes to making heavy forces lighter and more deployable and light forces more lethal and survivable. Project H84 provides the technology base required for solving materials-related problems in individual Soldier support equipment, armor, armaments, aircraft, ground and combat vehicles, and combat support. Project H7G funds the collaborative research efforts in nanomaterials technology between the ARL and the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology and the ISN industry partners. The effort is focused specifically on the improvement in individual Soldier protection. Project H7B funds congressional special interests associated with advanced materials for the full range of Army applications. Work in this PE is related to and fully coordinated with efforts in PE 0602618 (Ballistics Technology), PE 0602601 (Combat Vehicle and Automotive Technology), PE 0602782 (Command, Control, Communications Technology), PE 0602786 (Warfighter Technology), PE 0603001 (Warfighter Advanced Technology), PE 0603004 (Weapons and Munitions Advanced Technology), PE 0603005 (Combat Vehicle Advanced Technology), PE 0603008 (Command, Control, Communications Advanced Technology), and PE 0708045 (Manufacturing Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research laboratory and is intended to transition materials technologies and support the Army materiel efforts at the Armaments Research, Development, and Engineering Center, Picatinny Arsenal, NJ; the Tank and Automotive Research, Development, and Engineering Center, Warren, MI; the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL; the Natick Soldier Center, Natick, MA; the Edgewood Chemical and Biological Center, Edgewood, MD; and the Communications and Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	35051	18822	19209	19563
Current BES/President's Budget (FY 2008/2009)	34423	60102	18614	19029
Total Adjustments	-628	41280	-595	-534
Congressional Program Reductions		-230		
Congressional Rescissions				
Congressional Increases		41950		
Reprogrammings	-628	-440		
SBIR/STTR Transfer				
Adjustments to Budget Years			-595	-534

Twenty-two FY07 congressional adds totaling $40208 (after adjustment for Undistributed Congressional Adjustments) were added to this PE.

($958) Composites Materials Tech for Future Cbt Systems
($1917) Future Affordable Multi-Utility Materials for FCS
($1581) Materials Joining for Army Weapons Systems
($1246) Precision Polishing of Large Optics
($2876) MEMS Sensors for Rolling Elements Bearings
($3116) Spinel Tactical Armor Manufacturing Production Tec
($2204) Ultrasonic Consolidatn Matrix for Metal Composites
($3835) LRIP LASSO
($2109) Multifunctional, Nanostructured Materials for FCS
($1821) Airfield Matting System Replacement
($288) Con Sys f/Laser Powder Dep Mfg Process
($2252) Cutting Tools for Aerospace Materials
($2492) Erosian Resist Surface Eng for Helo Comp Blades
($1581) FCA Advanced Ballistic technology Program
($479) IED Simulation in Different Soils
($958) Lightweight Transparent Armor for Force Protection
($2588) Munition Shape Charge Control Research
($1917) Nanomanufacturing of Multifunction Sensors
($1294) Production of Turtle Shell Armor for E-SAPI
($1246) Structural Reliability of Smart Mun & Lgtwt Struct
($2492) Thermal Sprays for Polymeric-Based Ballistic Mitig

($958) Thermoplastic Composite Body Armor

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602105A - MATERIALS TECHNOLOGY**	**H7G**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H7G	NANOMATERIALS APPLIED RESEARCH	4797	5204	4905	5034	5203	5316	5393	5522

A. Mission Description and Budget Item Justification: This project funds the integration of government and industry scientific capabilities on research to advance innovative nanomaterials technologies and exploit breakthroughs in nanomaterials basic research toward improving Future Force Warrior survivability, lethality, and sustainability. This project funds collaborative research in nanomaterials technology between the Army Research Laboratory (ARL), the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology, and the ISN industry partners. The research is focused on nanomaterials and includes the development of models to facilitate the exploration of concepts for improving individual Soldier protection. Nanomaterial research holds promise in providing the capability to tailor the mechanical and thermal response of materials to enable desired performance improvements specific to the application of interest. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Devise and validate improved, physics-based, materials property models, and concepts for multifunctional, lightweight, and responsive hierarchical material technologies, and exploit breakthroughs in nanomaterials and multifunctional fiber processing technologies (e.g., scale-up of processes and fabricate into woven materials) to enable revolutionary Future Force Warrior protection capabilities. Coordinated research program conducted internally by ARL and externally through a collaborative effort with ISN and ISN industry partners. In FY06, investigated materials technologies to incorporate multi-material assemblies for multifunctional performance; devised nanoscale additives for protective coatings and inks; advanced materials concepts to enable photonic band gap fibers to be used in explosive detection systems; and scaled up fiber modifications for enhanced protection. In FY07, mature multi-functional materials concepts to include addressing scalable processing and fabrication methods; improve nanomaterials ingredients for sensor applications; and quantify performance of nanoengineered composite fabrics. In FY08, will research technologies to enable multifunctional designs utilizing multiple nanomaterial constituents. In FY09, will validate performance enhancements enabled through insertion of nanomaterials constituents in scalable processes.	4797	5081	4905	5034
Small Business Innovative Research/Small Business Technology Transfer Programs		123		
Total	4797	5204	4905	5034

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602105A - MATERIALS TECHNOLOGY**	**H84**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H84 MATERIALS	12374	13411	13709	13995	14197	14357	14673	14996

A. Mission Description and Budget Item Justification: This project provides the technical foundation for materials technology in metals, ceramics, polymers, and composites that are essential for lethal and survivable Future Force Systems, Future Force Warrior (FFW), and where feasible, can be exploited to enhance Current Force capabilities. In order to meet the challenge of Army transformation, new systems must be significantly lighter, more deployable, and more sustainable. Achieving such systems requires new material and structural solutions that offer significant weight reduction with improved performance, durability, and cost reduction for application to individual Soldier support equipment, armor, armaments, aircraft, ground combat vehicles, and combat support equipment. This project will address these needs through: nanomaterials research across the spectrum of applications to improve performance; improved, physics-based, material, mechanical, and structural models; high strain rate material characterization techniques; non-destructive inspection/evaluation technologies; new high strength/temperature materials and coatings; and advanced fabrication/processing methodologies. Applied research efforts are focused in armor/armament materials, as well as lightweight structural materials and materials affording protection against chemical, biological, or directed energy threats. Overarching goals of this material research are to provide optimized lightweight armor structures, improved affordable processing methods, and the development of modeling and simulation tools to facilitate future design efforts in support of FFW and other Future Force systems. The work is conducted by the Army Research Laboratory, at its Aberdeen Proving Ground, MD, and Hampton, VA, locations, and provides required technologies for advanced development programs at the Armaments Research, Development, and Engineering Center, Picatinny Arsenal, NJ; the Tank and Automotive Research, Development, and Engineering Center, Warren, MI; the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL; the Natick Soldier Center, Natick, MA; the Edgewood Chemical and Biological Center, Edgewood, MD; and the Communications and Electronics Research, Development, and Engineering Center (CERDEC), Ft. Monmouth, NJ. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Optimize lightweight armor materials/structures, processing methodology, and modeling and simulation tools to enable formulation of lightweight, frontal, and structural armors that will revolutionize the survivability of Current and Future Force platforms and tactical vehicles. In FY06, validated computational models were used to design and fabricate multi-material assemblies to achieve optimized multi-functional properties. In FY07, evaluate these multi-material assemblies against ballistic, mine blast, and other emerging threats. In FY08, will devise processing capabilities to fabricate multi-layer and hybrid materials; will prove ballistic multi-hit capability while maintaining single hit performance; will show capability to fabricate constant-radius, curved, transparent ceramic plates, and apply advanced polishing techniques. In FY09, will evaluate transparent armors and multi-layer/hybrid materials options against current and emerging threats; will provide computational models and simulations of lightweight air supported structures that allow for improved planning, and reduce the number of prototypes needed to develop new lightweight highly mobile medical tent systems.	3819	4015	4394	4467
Optimize lightweight armor materials and defeat mechanisms against emerging threats to enable affordable design of future multifunctional ballistic protective systems for the Future Force Warrior. Provide quantitative scientific basis for modeling and simulation that result in new lethal mechanisms/protection schemes for the individual warfighter. In FY06, exercised initial simulation codes against known threats and current protection schemes and refined models; incorporated lightweight armor materials and novel defeat mechanisms into concepts to improve Soldier extremity protection. In FY07, validate simulation and design tools for individual warfighter protection	2500	2550	2650	2730

and lethality applications and transition promising first generation protection/lethality concepts to development community. In FY08, will show simulation capability for multiple density target with complex projectile failures; will incorporate low density surrogate and multi-density range targets into assessment methodology. In FY09, will increase fidelity of simulation capability and transition second generation protection/lethality concepts to development community for the Future Force Warrior.				
Design, validate, and optimize advanced materials (ceramic, composite, polymers, lightweight, and high-strength metals) and processing techniques for smaller but more lethal penetrators/warheads and affordable, lightweight high performance armaments for revolutionary weapons effectiveness in urban and irregular operations. In FY06, characterized full scale penetrators and provided alloy/penetrator manufacturing process diagrams for production and transitioned to industrial partners; investigated behavior of metal matrix composites subjected to tensile load over the range of operational temperatures typical for cannons. In FY07, mature processes and techniques for fabricating ultra-fine grain materials that result in penetrators with improved strength and stiffness; identify and demonstrate a process for application of an erosion-resistant appliqué on a lightweight composite cylinder to enable future lightweight armaments. In FY08, will explore micro-mechanics effects of blast and impact shock on prospective warhead and projectile materials; will examine methods for controlled fragmentation of projectile body materials; will fabricate long metal matrix composite (MMC) sections with advanced liner material and will perform full scale experimental validation of MMC tube. In FY09, will design material system to provide the desired multi-functional capability to enhance damage on relevant targets and conduct benchmark experiments with that material system.	3555	4334	4165	4298
Design and optimize electro-ceramic materials and processing techniques for integration by CERDEC into advanced antennas that will enable affordable, reliable command, control, communications (C3) information for Current and Future Force platforms. In FY06, established life testing methodologies to evaluate reliability of thin film-based structures. In FY07, investigate novel material concepts to increase the temperature stability of active thin film materials. In FY08, will design and prove a materials reactor to grow thin films for tunable devices; will characterize microstructural, interfacial, and surface properties of the films grown. In FY09, will devise unique growth process science to achieve compositionally graded perovskite oxide thin film materials and will integrate the material into a specialized device structure.	500	500	500	500
Mature and scale-up nanomaterials processes, fabrication, characterization, and performance measures to enable revolutionary concepts for Future Force lethality and survivability beyond those addressed for individual Soldier protection in Project H7G. In FY06, devised nanomaterial concepts to produce lightweight transparent structural materials systems; matured processing methods to produce nanometallic materials; validated nanomaterial enhancements to improve structural and impact properties of polymer composite materials; devised nanomaterial additives for use in military coatings system improvements; and matured unique experimental and numerical methods to characterize the mechanical response of nanomaterials. In FY07, advance design capabilities for advanced nanomaterials and validate scalable processing methods; investigate effects of nanoengineering on the mechanical and physical properties of composite materials; quantify effects of nanomaterial modified coating systems on materials performance; modify and mature improved physics-based nanomaterials property models. In FY08, will perform parametric processing studies of advanced nanomaterial compositions; will apply modeling results to the maturation of reactive materials; will assess and validate performance of nanoengineered composite materials for survivability and lethality applications. In FY09, will scale-up the process methodology for fabricating fully-dense boron carbide plates; will perform microstructural and mechanical property characterization; will determine ballistic behavior of promising Al-based nano-micro composites.	2000	2000	2000	2000
Small Business Innovative Research/Small Business Technology Transfer Programs		12		
Total	12374	13411	13709	13995

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	49951	48575	39826	41017	41055	41483	42899	44337
140	HI-POWER MICROWAVE TEC	4860	5451	6154	6209	6275	6323	6462	6604
H15	GROUND COMBAT ID TECH	5297	5578	5974	7877	7960	8020	8196	8377
H16	S3I TECHNOLOGY	17030	16413	20607	19498	19209	19361	20291	21231
SA1	Sensors and Electronic Initiatives (CA)	13515	14093						
SA2	BIOTECHNOLOGY APPLIED RESEARCH	3499	3628	5503	5786	5911	6029	6162	6297
SA3	COMBAT IDENTIFICATION COMPONENT TECHNOLOGIES (CA)	5750	2176						
TS1	TACTICAL SPACE RESEARCH		1236	1588	1647	1700	1750	1788	1828

A. Mission Description and Budget Item Justification: The objective of this program is to research and evaluate technologies that will enhance the capabilities of the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Focus is on providing sensor, signal, and information processing technology for advanced reconnaissance, surveillance, and target acquisition (RSTA); ground-to-ground and air-to-ground combat identification (ID), fire control systems, fuzing, and guidance-integrated fuzing functions in future munitions; significantly improving the survivability, lethality, deployability, and sustainability of future tactical vehicles/platforms by devising high-power electronic components and technologies for compact, light-weight power and energy storage, power and energy conversion, and conditioning and radio frequency (RF)/microwave directed energy (DE) weapons. Project 140 funds research, development, and evaluation of RF weapon technology, high energy laser technology, and high power components. Project H15 funds research that will provide the ability for joint fires to locate, identify, track, and engage targets as necessary with the overall goal of increasing lethality and survivability through the reduction of fratricide. Project H16 funds studies that will provide the Soldier with decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments. In project SA2, the Army Research Laboratory in collaboration with the Institute for Collaborative Biotechnology (ICB) a University Affiliated Research Center (UARC) led by the University of California, Santa Barbara in partnership with California Institute of Technology and Massachusetts Institute of Technology and their industry partners conducts applied research focused on biological sensors and biological photovoltaic power generation. Work in SA2 will exploit breakthroughs in biotechnology basic research transitioning from the ICB to enable Future Force capabilities in sensors, electronics, and photonics. Projects SA1 and SA3 fund congressional special interest items. Project TS1 is a new project that funds research, development, and evaluation of space-based remote sensing, signal, and information processing technology in collaboration with other Department of Defense (DoD) and government agencies to support space force enhancement and space superiority advanced technology integration into Army battlefield operating systems.

Work in this program element (PE) is related to and fully coordinated with efforts in PE 0602307 (Advanced Weapons Technology), PE 0602705 (Electronics and Electronic Devices), PE 0602709 (Night Vision Technology), PE 0602782 (Command, Control, Communications Technology), PE 0603772 (Advanced Tactical Computer Science and Sensor Technology), PE 0603006 (Command, Control, Communications Advanced Technology), and PE 0603008 (Command Electronic Warfare Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the Army Research Laboratory and the Communications-Electronics Research, Development, and Engineering Center, Ft. Monmouth,

NJ, and US Army Space and Missile Defense Technical Center, Huntsville, AL.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	51327	38428	39295	40792
Current BES/President's Budget (FY 2008/2009)	49951	48575	39826	41017
Total Adjustments	-1376	10147	531	225
Congressional Program Reductions		-5945		
Congressional Rescissions				
Congressional Increases		16450		
Reprogrammings	-1376	-358		
SBIR/STTR Transfer				
Adjustments to Budget Years			531	225

Eleven FY07 congressional adds totaling $15767 (after adjustment for Undistributed Congressional Reductions) were added to this PE.

($1055) Advanced Detection of Explosives (ACE) Program
($1870) Prometheus Spectrometer Sys & Thazer Free Elec Las
($1869) Center for Advanced Microelectronics Manufacturing
($1294) High Brightness Diode Source (HiBriDS)
($1438) Lighter-than-air Unmanned Veh w/Scalable payload
($1869) ONYX OPTICS - Adv Bonded Diamond for Optical Apps
($958) Roll-to-Roll (R2R) Microelectronics in Spt of FDI
($958) Single Crystal Chem Vapor Dep Diamond Lens Element
($1390) Vertical/Horizontal Integ of Space Tech & Apps
($958) Wearable Video Capture System
($2108) Network Enabled Combat Identification

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**140**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
140 HI-POWER MICROWAVE TEC	4860	5451	6154	6209	6275	6323	6462	6604

A. Mission Description and Budget Item Justification: This project funds research and evaluation of traditional and non-traditional Radio Frequency (RF) and laser electronic attack. This includes traditional jammers, RF Directed Energy Weapon (DEW) technology as well as the high power components that will significantly enhance the survivability and lethality of Army platforms and related systems. The DEW effort studies both RF microwave and laser system capabilities and effects against various threats such as off- and on-route mines and electronically guided and fuzed missiles/munitions. Realizing DEW capabilities for diverse targets at a variety of lethality levels and operational ranges requires optimizing the DEW system including devising compact, high density power systems meeting stringent weight and volume restrictions. System optimization relies on determining the most effective DEW parameters and system components needed to defeat classes of selected targets; i.e., determining the desired DE effects drives the DEW component and system design, including power. Required power system components include power generation and storage, high-temperature/high power devices, power converters, and power conditioning. The ongoing DE effects and power component work is coordinated with and, as appropriate, leveraged by DEW and power/energy programs in the Air Force, Navy, High Energy Laser Joint Technology Office, Defense Threat Reduction Agency, national labs, university consortia, and relevant industry and foreign partners. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work on this project is performed by the Army Research Laboratory in coordination with the US Army Research, Development, and Engineering Command's Tank and Automotive Research, Development, and Engineering Center (TARDEC), the Armaments Research, Development, and Engineering Center, the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) and the Communications and Electronics Research, Development, and Engineering Center (CERDEC).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Research and evaluate materials and component structures that provide the higher energy density required by next generation Army systems such as electromagnetic armor, hybrid-vehicle propulsion electronics, directed energy sources, pulse power for Future Force systems, small unattended ground sensors, and Soldier systems. In FY06, investigated and matured silicon carbide (SiC) power modules for greater than (>) 20 kilowatt (kW) level power conversion at high temperature (90-150 degrees Celsius) for motor control, vehicle power bus, vehicle survivability, and lethality systems. Measured efficiency of SiC devices in converting beta and gamma energy into direct electrical current as power source for small unattended sensors. Modeled the generation and collection of the electron showers generated in SiC from radiation. Investigated path to more efficient Stirling engine through reduction of mass of individual engine components. Devised materials for higher energy primary and rechargeable power sources for the soldier. In FY07, mature high temperature SiC power modules for power conversion levels >100 kW. Design and build an isotope battery based on isotope material figures-of-merit, and SiC-conversion efficiencies. Measure efficiency of novel Stirling engine. In FY08, will mature development of high-temperature SiC power modules for operation at high temperature for power conversion levels >200 kW. Will investigate use of gallium-nitride (GaN) and diamond materials for use as direct energy converter in extended life batteries for unattended sensor and prognostics and diagnostics. Will model Stirling engine characteristics and optimize parameters for battery charging loads determined by CERDEC. Will investigate carbon-monoflourides alloys as anodes and continue work on high energy cathodes for Li-Air batteries. In FY09, will evaluate SiC power modules for operation at high temperature for power conversion levels >350 kW.	1313	1354	2416	2232

Research and mature novel solid-state laser concepts, architectures, and design components enabling High Energy Laser (HEL) technology for Army specific DEW applications. Exploit breakthroughs in laser technology and photonics basic research to meet the stringent weight/volume requirements for Future Force platforms. In FY06, investigated the most promising ceramic laser materials (Yb:Y2O3 and Yb:Sc2O3) for efficiency at room and cryogenic temperatures while fostering on-shore material development. Researched, designed, and fabricated efficient high-power laser based on highly concentrated neodymium-doped yttrium aluminum garnet (Nd:YAG) ceramics. Investigated diamond cooling technologies for advanced thermal management and beam quality improvement and transitioned these technologies to SiC for use as an optical heat sinking material. In FY07, investigate and evaluate the efficiency of the ultra-low quantum defect, high power "eye-safe" fiber laser (~1600 nm) with direct diode pumping by long-wavelength (InP) laser diodes (or surrogate narrowband fiber laser); conduct feasibility study of Tellurium Oxide (TeO2) as phase conjugate wavefront-correcting mirror for high power applications. In FY08, will evaluate composite ceramic laser materials to increase laser power; will evaluate volume Bragg grating based, spectral narrowing of diode pumps for high brightness pumping schemes. Will complete feasibility study of TeO2 for high power applications. In FY09, will implement a new approach to the thin disk laser architecture based on edge pumping of a composite doped-undoped gain element. Applied research will be conducted by ARL in close collaboration with domestic ceramic (and other) material vendors, university researchers, and major laser diode manufacturers.	1473	1798	2412	2449
Investigate, research, and evaluate technologies related to DEW technology, electronic warfare (EW) survivability/lethality, and supporting high power components to enhance the survivability/lethality of Army platforms. In FY06, collected, analyzed, and summarized RF effects susceptibility data on Radio Controlled (RC) threats and non RC controlled devices of interest to CERDEC. Designed and built threat neutralization system breadboard for robotic platform. Researched back-door, out-of-band coupling of RF energy into network components. In FY07, investigate integration of threat neutralization breadboard on countermine platforms and conduct lab/field experiment to show effectiveness. Investigate RF effects levels on threat mines of interest to CERDEC. Determine feasibility of RF DE countermine systems by identifying power/energy requirements. Design and if possible, build counter smart mine concept to show proof of principle and transition to CERDEC/PM Close Combat Systems. Investigate susceptibility profiles of network components to assess vulnerability of Future Force network. In FY08, will measure the RF susceptibility levels of threat sensors/communications of interest to CERDEC. Will use data to identify system design requirements for counter electronic system. Will build models to help predict the effective range of counter electronic system. Will investigate susceptibility profiles of wireless network components. In FY09, will design experimental counter electronic system and will conduct lab and/or field test to evaluate the capability. Will investigate feasibility of using RF DE to electronically attack air threats of interest to Air Defense Artillery Center and AMRDEC for Enhanced Area Air Defense. Will identify and acquire critical components of Unmanned Aerial Vehicles and evaluate failure levels. Will transition data and system design to AMRDEC for further evaluation. Will investigate susceptibility profiles for two Future Force systems.	2074	2218	1326	1528
Small Business Innovative Research/Small Business Technology Transfer Programs		81		
Total	4860	5451	6154	6209

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**H15**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H15 GROUND COMBAT ID TECH	5297	5578	5974	7877	7960	8020	8196	8377

A. Mission Description and Budget Item Justification: This project researches and investigates emergent combat identification (CID) technologies for joint, allied, and coalition air-to-ground and ground-to-ground mounted, dismounted, forward observer, and forward air controller missions for the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Efforts research enabling technologies to demonstrate a common battlespace picture for joint coalition situation awareness, reduction of weight and cost of previously developed CID systems, and evaluation of multiband radio frequency (RF) tags as a CID enabler. This project researches embedded radio algorithm developments as well as Soldier RF Tag hardware for multiband and aerial platform interoperability. This project increases the survivability and lethality of Coalition Forces by providing fusion of battlefield sensor and situational awareness data to identify friend from foe, thereby, reducing fratricide incidents across the battlefield. Additionally, this program investigates cost-effective sensors for use in threat warning systems for enhanced battlefield situation awareness and target cueing for Army ground combat vehicles. Coordination will be accomplished with other services, allies, and coalition partners. MANPRINT will be addressed in all activities. Efforts in this program element (PE) are coordinated with PE 0603270 (EW Technology), PE 0602270 (EW Techniques), PE 0603772 (Advanced Tactical Computer Science and Sensor Technology), PE 0602783 (Computer and Software Technology), and PE 0602784 (Advanced Concepts and Simulation).

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Combat Identification (CID) Technologies: This effort develops and evaluates potentially cost effective CID approaches that reduce fratricide, increase situational awareness (SA), and increase combat effectiveness of Soldier based and Brigade Combat Team (BCT) CID technologies. In FY06, identified the best approach for implementing triangulation techniques based on Global Position System (GPS) and signal time of arrival to identify the location of battlefield entities called Geometric Pairing (GP), RF Tag/Interrogator CID functionality, and crypto functions into application specific integrated circuits (ASICs). In FY07, design GP and RF Tag hardware for the ground Soldier to demonstrate dismounted integration concepts and technical performance characteristics; conduct first technical evaluation of GP situation awareness and RF Tag concepts. In FY08, will conduct final technical testing of representative models of GP and RF Tag technologies in a high fidelity lab environment and final technical testing of millimeter Wave (mmW) ID ASICs in a high fidelity lab facility; will complete regression tests of mmW ID ASICs to validate compliance with STANAG (NATO Standardization Agreement) 4579; will conduct virtual experiments with hardware in the loop for BCT ground-to-ground technologies. In FY09, will initiate study of integrated approach for net centric architecture for CID; will investigate embedding CID waveforms into FCS and JTRS; will investigate and explore promising technologies for providing foe and neutral identification; will initiate study of potential CID for dismounted Soldier mission area; will investigate tools for determining cost effectiveness of CID capabilities and coordinate with services, allies, and coalition partners for their participation. Related work is also accomplished under PE/Project 63270/K16.	1335	1592	1887	7877
Cueing Sensor: This effort develops low cost infrared sensors that detect rocket propelled grenades, anti-tank guided missiles, and tank fired kinetic energy and high energy anti-tank rounds and then cue active protection system for Army vehicles. In FY06, investigated	2140	2847	2900	

algorithms for on-the-move frame registration, clutter suppression, and specific threat classification for active protection threat cueing sensor; developed focal plane arrays (FPA) with required array uniformity, operability, sensitivity in the desired spectral bands. In FY07, develop cueing sensor algorithms and processing; perform live-fire test of prototype sensors and systems. In FY08, will optimize FPA design; enhance sensor, electronics, and algorithms for on-the-move environment. Related work is also accomplished under PE/Project: 62270/442; 63270/K15; 63772/243.				
Fusion Based Technologies: This effort develops an advanced knowledge generation capability to provide actionable intelligence enabling timely decision-making by commanders and timely action by Soldiers in the execution of operations. In FY06, investigated and evaluated fusion architectures, algorithms, representations, and data mining capabilities; initiated software generation in situation development; evaluated fusion capabilities by expanding to a moderate-sized set of reports (structured, semi-structured, and unstructured situational input); demonstrated 3000 reports/hr processed (scenario-specific performance, and sophisticated spatial/temporal reasoning); demonstrated data retrieval integrated with search engine. In FY07, demonstrate capabilities in identification and tracking of force aggregates in information noisy scenarios with realistic terrain characteristics and demonstrate initial capabilities for inferring enemy objectives/intent in conventional and asymmetric scenarios. In FY08, will develop expanded set of representations for different types of enemy tactics to handle more complex scenarios including the prediction of locations of specific types of asymmetric attacks using real data.	1822	1007	1187	
Small Business Innovative Research/Small Business Technology Transfer Programs		132		
Total	5297	5578	5974	7877

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**H16**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H16 S3I TECHNOLOGY	17030	16413	20607	19498	19209	19361	20291	21231

A. Mission Description and Budget Item Justification: The objective of this project is to provide the future Soldier with decisive new capabilities to locate, identify, and engage battlefield targets in tactical and urban environments. This project is focused on applied research of advanced sensors, signal processing, and information technologies to enable these capabilities for the Future Force and other emerging thrusts. The ultimate impact and utility of this work will be to protect Soldiers and to greatly increase their lethality and range and speed of engagement. Emphasis is on solving critical Army-specific battlefield sensing and information management problems such as false targets, complex terrain (including urban applications), movement of sensors on military vehicles, etc. Cost reduction is a key focus. Significant areas of research include: low cost sensors designed to be employed in large numbers as unattended ground sensors (UGS) for force protection, homeland defense, minefield replacements, counter terrorism operations, and munitions; Tagging, Tracking, and Locating (TTL) of non-traditional targets; fusion of diverse sensors such as acoustic, seismic, magnetic including the Micro Electro Mechanical System (MEMS) magnetic flux concentrator, radar, infrared (IR), Forward Looking IR (FLIR), Laser Detection and Ranging (LADAR), visible imagers, etc.; low cost acoustic, seismic, and magnetic sensors that can passively detect and track battlefield targets such as tanks, helicopters, etc., and locate gun fire; sensor technologies for the detection and tracking of humans, especially in urban terrain; high performance multi-function radio frequency (RF) systems that allow target acquisition, combat identification (ID), active protection, surveillance, and communications systems consolidated into a single system, reducing system cost, and size; passive and active RF sensors capable of high-resolution imaging to detect targets hidden in foliage, smoke, and fog; ultra wideband radar work enabling buried mine detection and target imaging through dense foliage and greatly enhanced robotic mobility; aided/automatic target recognition (ATR) allowing sensors to autonomously locate and identify targets; Opto-Electronic (OE) interconnects and processors are being built to greatly speed the movement of information within and between electronic digital processing units to facilitate smart sensors, adaptive sensors, and sensor fusion; advanced battlefield sensor and information processing to conduct a dynamic and real time situational assessment to present a common picture of the battlespace focused on low echelon commanders; advanced information processing methods to provide automatic information technologies that utilize widely dispersed sensor and legacy information sources; sensor and eye protection against laser threats, and algorithms for acoustic sensors mounted on a Soldier's helmet to localize source of gunfire. Work is coordinated with outside organizations, particularly the Night Vision Electronic Sensors Directorate, other Research and Development Engineering Centers (RDECs), and the Defense Advanced Research Projects Agency (DARPA). This work is related to and fully coordinated with efforts funded in PE 0602709A (Night Vision Technology), PE 0603710A (Night Vision Advanced Technologies), and PE 0603001A (Warfighter Advanced Technology). The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this area is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Mature technologies for low-cost UGS to enhance persistent Army sensing capabilities. Research focus is based on opportunities and feedback from UGS used in OIF. A key focus is on detecting people. Investigate fusion algorithms using multi-modal sensing phenomenology including acoustic, seismic, magnetic, electric field (E-field), passive IR, and RF to increase probability of target detection and reduce false alarms. In FY06, evaluated multi-modal database and fusion algorithms using RF, magnetic, E-field, seismic, and acoustic sensor technologies required for human infrastructure detection. Investigated new force protection concepts using visible and IR imagery, adaptive classification, hyperspectral (HS), and change detection algorithms. Investigated the fusion of multi-band IR sensors for target detection. In FY07, devise and mature algorithms for low cost persistent sensing and change detection. Design biomimetic	4080	3330	3816	4696

acoustic sensing systems for a helmet mounting; evaluate low cost, high sensitivity magnetic sensor, and evaluate E-field sensor suitability for low cost UGS. Design and evaluate fusion algorithms for multi-band IR sensor target detection, integrate advanced multi-target tracking techniques for imagery to enhance force protection and adapt ATR methods for multimodal fusion. In FY08, will prepare 1st generation multi-modal algorithms for fielding in Army UGS systems; will evaluate use of HS technology, including band selection techniques for target detection; will create image enhancement algorithm toolbox to enable feasibility studies; will optimize and transition the high sensitivity magnetic sensor and extend advanced infrasonic algorithms to extract a larger class of transient events. In FY09, will evaluate the combination of advanced imaging sensor types for ATR such as polarimetric FLIR with LADAR; will extend autonomous acoustic sensing and processing algorithms to new platforms; will investigate use of magnetic and E-field sensors on vehicles.				
Investigate and mature hyper-modal sensor data fusion for detecting and classifying human infrastructure in urban operations such as machinery, RF emissions, chemicals, and computers in hidden and confined spaces such as tunnels, caves, sewers, and buildings. In FY06, investigated and evaluated hyper-modal sensor data fusion on a mobile platform for detecting and classifying human infrastructure presences such as machinery, RF emissions, chemicals, and computers in hidden and confined spaces such as tunnels, caves, sewers, and buildings. Actions included collection of hyper-modal co-registered sensor data and signatures in relevant environments, design of robust hyper-modal sensor fusion algorithms, and development of fusion algorithm criteria. In FY07, design detection algorithms and begin sensor fusion algorithm maturation for imagery. Evaluate a correlation matrix to establish relationships between sensor detection capabilities and relevant target signatures. Collect additional multimodal data. In FY08, will experimentally validate an integrated hyper-modal sensor testbed tailored for urban operations; will devise node-based algorithms for detecting human infrastructure and presence in hidden/confined spaces and will establish a database of co-registered, hyper-modal relevant signatures and features that are detectable with available sensor technologies. In FY09, will investigate the application of sensor fusion algorithms and sensor networks to new Army applications, such as force protection and homeland security applications.	3600	3510	3700	2072
Conduct applied research that will result in technology advances for clandestine TTL for non-traditional hostile force and non-cooperative targets. Specific technical objectives, products, and deliverables are classified and in accordance with the Hostile Forces TTL Capabilities Development Document (HFTTL CDD) and the TTL Science and Technology Roadmap. This effort will directly support CERDEC's advanced research in clandestine TTL and will in turn be supported by basic research in TTL. In FY08 technologies to be researched and matured will be extremely wide ranging and may include but are not limited to microtechnology, Micro Electro Mechanical System (MEMS), nanotechnology, low-power chip based radar, birefringent taggants, LADAR, hyperspectral imaging, polarimetric imaging, biomimetics, and carbon nanotubes. Technologies that have the potential to be transitioned into advanced research of clandestine TTL will be identified and research to mature these areas will be conducted. In FY09 technologies selected for further exploration will begin to be matured. Multi-functional multi-device and algorithm implementations will be explored. Technologies that are of sufficient technology readiness will transition to advanced research.			1189	1397
Research, mature, and validate electro-optical techniques and components to protect sensors and eyes from threat laser sources on the battlefield; target redesign of optical devices and explore new nonlinear optical materials for protection. In FY06, investigated and evaluated magneto-optical and electro-optical switches for fast shuttering of optical systems. In FY07, design and evaluate multi-element magneto-optical switches and characterize response time. In FY08, will investigate large-area fast electro-optic shutter devices and evaluate nonlinear optical tandem limiters. In FY09, will evaluate demonstrator protection devices across the visible spectrum.	2338	2478	3078	2652
Mature technical underpinnings of ultra wideband (UWB) radar for several key Army concealed target detection technology requirements including landmine detection, through-the-wall sensing, and obstacle detection. Validate advanced computational electromagnetic algorithms and estimate performance of proposed radar systems as well as predict target signatures. Characterize target and clutter scattering behavior in support of advanced image formation and detection algorithm development. Transfer predictions and algorithms to	2989	2979	3809	3807

landmine detection, through-the-wall sensing, and robotic perception programs. In FY06, completed fabrication and evaluation of an advanced affordable (under $25K/unit) UWB radar in support of unmanned ground vehicle (UGV) perception requirements. In FY07, mature advanced through-the-wall imaging capabilities consistent with a randomized, distributed array implementation concept. In FY08, will examine techniques to combine radar data with other advanced perception sensors to improve obstacle detection on autonomous navigation systems. In FY09, will devise radar concepts and supporting algorithms to enable Army ground vehicles to survey the forward looking hemisphere for concealed targets including hidden personnel and large arms caches in buildings and various mine deployments.				
Mature Multi Function Radio Frequency System (MFRFS) for use on small ground and air vehicles and future Soldier technologies. Mature understanding of phenomenology for an integrated RF sensor that performs radio, radar, and control functions to allow communications, combat ID, target acquisition/track, active protection, and munition command guidance. Mature Aluminum-Gallium-Nitride based semiconductor Ultra Violet (UV) optoelectronics for covert line-of-sight and non-line-of-sight communications and for photoluminescent detection of bio-threats. In FY06, implemented and evaluated four channel MFRFS receiver design; evaluated close in active protection radar; and designed RF imaging and collision avoidance radar for robotic perception. Investigated long range detection and tracking waveform for kinetic energy projectiles. Transitioned UV emitters to the Edgewood Chemical and Biological Center with enhanced efficiency into Army bio-sensor R&D programs. In FY07, establish MFRFS radar model for use in analyzing the radar limitations in adverse environments and evaluate RF imaging and collision avoidance radar for robotic perception. Explore high-brightness active regions for LEDs and lasers operating at wavelengths below 300 nm for UV covert communications and bio-agent detection. In FY08 will evaluate communication functionality with MFRFS demonstration array and will investigate methods for increasing communication rates achievable with MFRFS hardware and explore integrated receiver/exciter design and develop methods for increasing frequency flexibility. Will investigate UV laser development in the 280 nm to 340 nm range. In FY09, will evaluate methods for detecting stationary dismounts using biometric signatures and develop waveforms and algorithms for implementing these techniques in MFRFS. Will investigate feasibility of solar-blind 280 nm avalanche photodiode.	1523	1553	2339	2270
Improve the lower echelon commander's (i.e. platoon) situational understanding in complex/urban terrain by maturing infrastructure and validating algorithms, filters and agent technologies to reduce cognitive load by fusing information. In FY06, improved asset discovery and control software framework and fusion algorithms that correlate/fuse the local picture from a suite of unattended ground sensors and highly mobile manned and semi-autonomous sensor nodes within an ad hoc networking environment. Software components will be transitioned to CERDEC for end-user evaluation within the Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance On-the-Move (C4ISR-OTM) experiment. In FY07, explore robotic asset management and control technologies in order to enable semi-autonomous assets with the ability to provide persistent surveillance. In FY08, will define robotic asset control technologies and investigate bio-inspired asset behavior algorithm as software components within a stimulation environment. Using an existing virtual stimulation environment, will define scenarios for evaluating algorithms prior to lab experimentation. In FY09, will conduct lab experiments in order establish a baseline for evaluating the effectiveness of bio-inspired asset management for providing persistent surveillance for detecting and monitoring activity within a limited activity dynamic urban scene. From this baseline, will devise and mature algorithms to scale to more complex scenes.	2500	2500	2676	2604
Small Business Innovative Research/Small Business Technology Transfer Programs		63		
Total	17030	16413	20607	19498

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**SA2**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
SA2	BIOTECHNOLOGY APPLIED RESEARCH	3499	3628	5503	5786	5911	6029	6162	6297

A. Mission Description and Budget Item Justification: The objective of this project is to transition maturing biotechnology research from the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center (UARC). The ICB is led by the University of California, Santa Barbara (Santa Barbara, CA) in partnership with the California Institute of Technology (Pasadena, CA) and the Massachusetts Institute of Technology (Cambridge, MA). The ICB is focused on advancing the survivability of both the Soldier and weapons systems through fundamental breakthroughs in the area of biotechnology. This project will conduct applied research that transitions breakthroughs in biotechnology basic research from the ICB to enable revolutionary Future Force capabilities in sensors, electronics, photonics, and network science. Areas of applied research include bio-array sensors, biological, and bio-inspired power generation and storage, biomimetics, proteomics, genomics, network science, DNA research and development, control of protein, and gene expression. Efforts include designing and performing multi-scale dynamic and predictive modeling to understand biologically-inspired "sense and respond" systems (integrated system of sensor, information processing, and response mechanism) and their components. The Army Research Laboratory (ARL) and other Army laboratories, including the Natick Soldier Center (NSC) and Edgewood Chemical Biological Center (ECBC), in collaboration with the ICB industry partners will conduct applied research focused on biological sensors, biological, and bio-inspired materials, and biological and bio-inspired power generation and storage. This applied research effort will ensure that the basic science developed at the ICB is directed towards and transitioned to Army devices and systems. The in-house research program (~20%) will link the ICB research to Army requirements and enhance the transition of this technology into the Army. Most of the funding (~80%) is focused on competitively awarded joint projects led by an ICB Industrial partner in collaboration with an Army laboratory and an ICB faculty member to transition ICB research into the Army and industry. The projects are programmed for three years each and are reviewed annually. Projects are intended to cover the entire breadth of the ICB 6.1 program. The process of transformation requires revolutionary advances in performance of Army weapons systems, including improvements in engineered systems impacting Soldier survivability. The ICB will conduct unclassified basic scientific research in: sensors, electronics, information processing and the technical fundamentals enabling development of advanced capabilities in these application areas. The Army seeks to provide the interdisciplinary fundamental knowledge and technical capabilities to manipulate biological systems and components, and to exploit biologically derived products and processes for both the Soldier and engineered systems and platforms. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL) in coordination with the Edgewood Chemical Biological Center (ECBC), Natick Soldier Center (NSC), and other Army laboratories.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Institute for Collaborative Biotechnologies: In FY06, investigated the use of the biologically-based and inspired sensors and materials to design and fabricate "sense and respond" system components; devised and experimentally validated a laboratory scale biological sensor, which will be more selective, compact, and provide a significantly reduced logistical burden. Evaluated and optimized microbes for use in microbial fuel cells. In FY07, identify biologically-based and inspired sensors and materials to design and fabricate "sense and respond" system components, investigate biologically-inspired control, and networking capability for these systems; evaluate the biological sensors in a relevant environment and transition to ECBC and/or NSC. Initiate fabrication of microbial fuel cells and optimize power output for low power sensor applications. Establish baseline methodologies for comparisons of novel molecular recognition elements (MREs) devised using rapid micro-fluidic screening and currently used antibodies. In FY08, will design biologically-based and inspired sensors and materials for "sense and respond" systems components and determine the feasibility of biologically inspired control and network	3499	3535	5503	5786

systems for these devices, investigate high-throughput screening of microbe, and fuel candidates for microbial fuel cells, waste reclamation, and bioremediation. Optimize and perform side-by-side comparison evaluation of novel MREs and standard antibody using baseline methodologies. In FY09, will optimize the design of biologically-based and inspired sensors and materials for "sense and respond" systems components and investigate incorporation of biologically-inspired control systems and networks in the "sense and respond" architecture, investigate bioelectronic properties of biologically-derived conductive nano-fibers. Establish supporting infrastructure to select MREs using novel micro-fluidic system in coordination with ECBC transition partners.				
Small Business Innovative Research/Small Business Technology Transfer Programs		93		
Total	3499	3628	5503	5786

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602120A - Sensors and Electronic Survivability**	**TS1**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
TS1 TACTICAL SPACE RESEARCH		1236	1588	1647	1700	1750	1788	1828

A. Mission Description and Budget Item Justification: The objective of this new project is to research and evaluate space-based technologies that will enhance ground capabilities of the Future Force and where feasible, exploit opportunities to enhance the Current Force capabilities. Focus is on space-based remote sensor, signal, and information processing technology for space-to-ground applications for advanced intelligence, surveillance, and reconnaissance (ISR), battle command, control, and communications, target acquisition, position/navigation, threat warning, and space superiority technology for force protection. The space-based applied research leverages other DoD space science and technology to support space force enhancement cooperative satellite payload development for advanced technology integration into battlefield operating systems. This includes applied research in persistent intelligence, surveillance, and reconnaissance and dedicated communications for in theater high altitude long loiter and operationally responsive space payload applications. In addition, this project includes research and evaluation of ground-to-space superiority technologies against remote sensor and communications capabilities and space object identification and characterization. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Space and Missile Defense Technical Center in Huntsville, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY07, will conduct research to leverage other DoD space science and technology, including high altitude long loiter, operationally responsive, space and small tactical satellite payload technologies for battlefield communication, and ISR applications. In FY08, will exploit tactical satellite and high altitude long loiter platform technologies that accommodate operationally responsive wideband communications and wide area surveillance for improved sensor, signal, and data processing payload capabilities. In FY 09, will continue research and evaluation of payload/platform technologies to provide a technology baseline for Army advanced space technology applications and/or other DoD space technology cooperative payload development.		1201	1588	1647
Small Business Innovative Research / Small Business Technology Transfer Programs		35		
Total		1236	1588	1647

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602211A - AVIATION TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	38073	40156	42567	42051	41573	41181	41944	40224
47A	AERON & ACFT WPNS TECH	28612	28157	38392	37809	37286	36862	37530	35713
47B	VEH PROP & STRUCT TECH	3999	4285	4175	4242	4287	4319	4414	4511
47C	ROTORCRAFT COMPONENT TECHNOLOGIES (CA)	5462	7714						

A. Mission Description and Budget Item Justification: The Aviation Applied Research Technology program element (PE) conducts research and expands scientific knowledge applicable to both manned and unmanned rotary wing vehicle (RWV) technologies in support of the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. Emphasis is on developing rotary wing platform technologies to support manned and unmanned rotary wing vehicle combat and combat support operations for attack, reconnaissance, air assault, survivability, and command and control missions. Technologies that enable autonomous flight, higher aerodynamic loads, lower detectability, and increased maneuverability are emphasized. Increased effort is being placed on technologies to increase both manned and unmanned aircraft survivability, crashworthiness, and crew protection. Prognostics and diagnostics technologies are being developed and evaluated to support Condition Based Maintenance (CBM) efforts desired to reduce Operating and Support (O&S) costs of Current and Future Force airframes. This PE advances integrated unmanned operations through autonomous collaboration and refinement of unmanned technologies. This PE also supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry, and academia. Project 47C funds congressional special interest items. Efforts under this PE transition to projects supported by PE 0603003A (Aviation - Advanced Technology). Department of Defense (DoD) systems such as the AH-64 Apache, UH-60 Black Hawk, CH-47 Chinook, Armed Reconnaissance Helicopter, Light Utility Helicopter, the U.S. Navy SH-60 Seahawk, and U.S. Marine Corps V-22 Osprey, AH-1 Cobra, and CH-53 Super Stallion benefit and are supported directly or indirectly by this PE. This PE does not duplicate any efforts within the Military Departments and supports Project Reliance for which the Army is the lead service for the maturation of rotorcraft science and technology. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Aviation and Missile Research, Development, and Engineering Center, with facilities located at Redstone Arsenal, AL; Fort Eustis, VA; Moffett Field, CA; and Hampton, VA, and at the Army Research Laboratory, with facilities located at Adelphi, MD; Hampton, VA; and Cleveland, OH.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602211A - AVIATION TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	39424	32804	33747	34126
Current BES/President's Budget (FY 2008/2009)	38073	40156	42567	42051
Total Adjustments	-1351	7352	8820	7925
Congressional Program Reductions		-153		
Congressional Rescissions				
Congressional Increases		7800		
Reprogrammings	-1351	-295		
SBIR/STTR Transfer				
Adjustments to Budget Years			8820	7925

FY08 and FY09 funds increased to support additional efforts in aircraft survivability and operational support and sustainment technologies.

Five FY07 congressional adds totaling $7477 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1726) Center for Rotorcraft Innovation
($2492) Composite Small Main Rotor Blades
($1054) Aircraft Struc Condition Monitoring f/Diag/Prog
($1246) Limited Visibility Landing System
($959) T&E of Energy Attenuating Seat for Mili Aircraft

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602211A - AVIATION TECHNOLOGY**	**47A**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
47A	AERON & ACFT WPNS TECH	28612	28157	38392	37809	37286	36862	37530	35713

A. Mission Description and Budget Item Justification: The Aeronautical and Aircraft Weapons Technology project develops Rotary Wing Vehicle (RWV) technologies for manned and unmanned Army / Department of Defense (DoD) rotorcraft to increase strategic and tactical mobility / deployability; improve combat effectiveness; increase aircraft survivability; and improve combat sustainability. This project supports the Future Force by providing technology to improve capabilities in Force Application and Focused Logistics. Areas of research involve technology applicable to all aviation platforms, such as enhanced rotor efficiencies, improved survivability, increased structure and airframe capability, improved engine performance, improved sustainability, improved mission avionics performance, and reduced cost of unmanned and manned aerial vehicles. This project supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry, and academia. The propulsion technologies investigated in this project provide improved specific fuel consumption, horsepower to weight ratios, and operation and support (O&S) cost savings for manned and unmanned systems. These engine component technologies address engine needs for future aircraft with up to a 50 percent endurance and 30 percent payload increase over currently available turbine engines. These component technologies may also lead to a 33 percent increase in payload and a 50 percent reduction in fuel consumption for current rotorcraft; and an 80 percent payload and a 20 percent combat range increase for future rotorcraft. Aircraft survivability component technologies include adaptive Infrared (IR) signature suppression of engine and airframe thermal sources, visual signature control, acoustic signature attenuation, in-cockpit threat situational awareness, and survivability re-route decision aiding systems. Advanced active controls, aerodynamics, handling qualities, and smart materials (materials that respond to specific stimuli) technologies provide rotors and flight controls capable of increased payload, range, agility, maneuverability, and survivability. Manned / unmanned system interfaces, autonomous collaborative flight controls, flight simulation, weapons and sensor integration, pilot-vehicle interface technologies, and advanced mission equipment packages are being pursued that provide full spectrum engagement, precision and selectable lethality, suitable for the target and engagement scenarios. The operations and sustainment technologies provide advanced prognostic / diagnostic algorithms necessary to implement Condition Based Maintenance (CBM). This project leverages work accomplished in collaboration with the National Aeronautics and Space Administration (NASA). Technologies within this project will transition to advanced technology development programs with application to future, as well as current, Army / DoD rotorcraft systems. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Aeroflight Dynamics Directorate of the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), located at the NASA Ames Research Center, Moffett Field, CA; the NASA Langley Research Center, Hampton, VA; and the Aviation Applied Technology Directorate, Fort Eustis, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
National Rotorcraft Technology Center (NRTC): In FY06, developed fluid damper and magnetic-particle damper models. Designed, developed, and tested an active hinge pin actuator assembly. Investigated lean qualification methodology for composite materials and processes. Tested an actuation system for download alleviation. Developed simulation models for ad-hoc networking of rotorcraft teams. Investigated loose and tight coupling of Computational Fluid Dynamics (CFD) and Computational Structural Dynamics analyses for improved rotor loads and performance prediction. Designed servoflap-controlled soft torsion rotor system and performed noise abatement/land use planning flight tests. Developed 3-D CFD icing prediction methods. In FY07, incorporate and evaluate fluid damper and magnetic-particle damper models in comprehensive analyses. Design and test wireless proximity sensors. Conduct passive layered	6947	7637	8461	8631

isolator flight test demonstration. Perform simulation test of ad-hoc networking of rotorcraft teams. Develop advanced sensors and networks for a practical condition based maintenance implementation. Design improved crashworthy armored seats. Develop metal matrix composite design for airframe applications. Design drive train torque measurement system. In FY08, will perform wind tunnel tests of rotor designs with improved static/dynamic stall characteristics. Will test oscillatory jets on rotor airfoils. Will perform qualification test on improved drive system gears. Will test improved crashworthy armored seats. Will test metal matrix composite design for airframe applications. Will investigate and evaluate a drive train torque measurement system. In FY09, will perform bird strike and head impact simulations for rotorcraft crashworthiness and survivability. Will conduct certification testing and probabilistic analysis to evaluate damage tolerance methodologies. Will test advanced drive system designs. Will evaluate active crash protection system.				
Rotor Technology: In FY06, initiated development of mach-scale model rotor blades for model subsystem tests. Completed planning for wind tunnel testing of lightweight rotor and hub concept for application of on-blade control, including comprehensive analysis predictions. In FY07, test in wind tunnels, active/passive integration techniques for enhancement of on-blade controls, both for blade section concepts as well as two model rotor designs. Analytical model validation will also be included. In FY08, will evaluate, via wind tunnel tests, on-blade control for model rotor system to include performance enhancement and primary control.	4008	4093	3282	
Robotics Collaboration: In FY06, conducted simulations and assessments of three technical approaches to Autonomous Collaborative UAV behaviors at contractor and government facilities, and flight tested one of the three approaches using multiple small UAVs.	2872			
Aircraft Survivability Technologies: In FY06, evaluated the effectiveness of and refined the Threat Lethality Predictor (TLP) system and associated algorithms, which provides highly-accurate, on-aircraft, near real-time assessments of infrared and radar threats' ability to engage, with and without countermeasures, and in terrain clutter. In FY07, develop cognitive decision aiding (CDA) planners that enable a manned/unmanned team to respond to pop-up threats as a team, and not just as individual platforms. Integrate the CDA planners with the TLP algorithms. Develop CDA-TLP specific cockpit controls, displays, and aural cues. Refine performance and mission effectiveness goals using simulation. In FY08, will initiate development of crash criteria (that establishes required G-loads that structures such as engines and transmissions must withstand before breaking-away during a crash and threatening the integrity of crew occupied areas) for "full-envelope crashworthiness" based on rotorcraft size class and mission type. Will develop conventional ballistic threat and advanced crew protection concepts followed by preliminary designs for selected concepts. Will investigate specific technologies to reduce susceptibility to MANPADS threats including large engine (15,000 shp class) infra-red (IR) suppressors and tailorable visual/EO airframe coatings and films. In FY09, will develop updated design guidelines based on emerging criteria. Will complete preliminary design of candidate IR suppressors, followed by component fabrication, component-level testing, and conclude with subsystem-level evaluation. Will perform experimental testing on the most promising of the large-engine IR suppressors and tailorable visual/EO airframe coatings and films examined in FY08.	4032	4108	7800	7186
Rotorcraft Airframe Technology: In FY06, generated and evaluated structures that incorporate ballistic protection and survivability features and evaluated and refined concepts that contain self-sensing and self-healing components. In FY07, refine multifunctional structure technology, reducing parasitic weight by adding capabilities to primary structure (e.g., integrated armor). Modify technologies to improve structural efficiency and lower design load uncertainty on airframe/rotor structures. Develop criteria using a strain-allowable approach for repair and continued use of ballistically damaged, life-limited, dynamic structures. In FY08, will develop integrity management by fusing loads monitoring and damage detection capabilities to improve safety and survivability. Will evaluate ballistic properties and effectiveness of reduced-weight multifunctional structural armor. In FY09, will conduct laboratory testing to evaluate strain-allowable integrity approach; and will develop emerging platform concepts and validate modeling fidelity.	2236	2447	1261	4221
Advanced Engines: In FY06, completed design of advanced ceramic matrix composite power turbine for improved performance with	977	1391	1980	2050

reduced weight. Developed advanced foil bearing with the goal of eliminating need for lubricants and reducing supportability costs. Tested foil bearing via rig-test to validate weight reduction and reduced maintainability issues. Completed fabrication and conducted rig-test of 700 horsepower class ceramic turbine to validate improved performance and reduced weight. In FY07, complete fabrication and conduct test of advanced ceramic matrix composite power turbine blades to validate improved performance, reduced weight and increased durability. In FY08, will complete design of advanced compressor for improved engine performance and reduced weight; and will complete advanced combustor design, fabrication, and evaluation. In FY09, will complete design of advanced inlet particle separator that will improve engine performance and durability. Will complete fabrication of advanced compressor for improved engine performance and reduced weight. Will complete advanced combustor rig-test to validate improved performance and weight.				
Network Operations and System Integration and Intelligent and Active Control: In FY06, began development of the technologies for autonomous low-altitude obstacle avoidance. Tested low-altitude 2D autonomous navigation through obstacle field using laser radar and stereo cameras. Investigated 3D obstacle avoidance in a simulation environment to help decide on best technical approach. Applied control law analysis tools using the Rotorcraft Air Crew Systems Concepts Airborne Laboratory (RASCAL) in-flight simulator for the UH-60M upgrade fly-by-wire control system. In FY07, validate closed-loop individual blade control model with full-scale wind tunnel test. Complete external load stabilization testing with aerodynamically active sling loads in actual flight. Digital Situational Awareness Testbed: In FY06, developed interface testbed for investigating control/display variants for control of multiple UAVs from mobile platform. In FY07, will develop guidelines for control of multiple UAVs from a single station (either airborne or ground). In FY08, will develop and evaluate supervisory control interface for multiple heterogenous UAVs. In FY09, will conduct tests of supervisory control techniques for control of multiple UAVs. Advanced Rotary Wing Concepts: In FY06, initiated integration of advanced targeting and stabilization technologies to provide a precision attack capability for rotary wing UAVs. In FY07, support flight test demonstrations of precision attack capability from test bed UAVs operating in support of manned aviation and ground troops in a MOUT environment. In FY08, will conduct flight test demonstrations using different sensors and weapons systems to gauge precision to be expected from rotary wing UAVs in varying flight modes, i.e., high and low hover, firing on the move, and moving targets. In FY09, will assess stability of weapons platforms in varying wind and environmental conditions to predict affect on weapons' precision.	7540	8233	8408	7571
System Concepts Studies: In FY08, will examine rotorcraft technology areas to determine where science and technology investments can best be invested to meet the emerging needs of the user. Possible investigations may include the Joint Multi-Role Aircraft, Optimum Speed Rotor, Quad Tilt-Rotor, Advancing Blade Concept, and Optimum Speed Tilt-Rotor. In FY09, will continue to study new technology areas in concert with the requirements generation process and planning guidance to determine future investment needs.			2150	3000
Durability and Sustainment Techs: In FY08, will initiate development of prognostic algorithms for dynamic rotor head components. Will develop predictive models for hydraulics and actuators used for aircraft flight controls (based on Failure Modes, Effects, and Criticality Analysis and manufacturer's analysis of failed components). Will evaluate the predictive models based on the fusion of the data-driven and model-based approaches, with bench testing of components to verify the models. Will determine placement of corrosion sensors for use in development of corrosion assessment algorithms. Will perform rig-testing of ceramic components to characterize the failure modes. Will embed sensors in structural components and assess feedback to form basis of damage detection algorithms. Will evaluate sensor and loads monitoring feedback methods for structural diagnostics/prognostics, and reduction of uncertainty in probabilistic methods for life management. In FY09, will perform rig-testing of dynamic rotor head components, begin bench testing of flight control algorithms on hydraulic actuators, initiate development of prognostic algorithms for ceramic components, develop the corrosion damage algorithms, and assess structural damage detection algorithms. Will evaluate sensor and loads monitoring feedback methods for structural diagnostics/prognostics, and reduction of uncertainty in probabilistic methods for life management.			5050	5150
Small Business Innovative Research/Small Business Technology Transfer Programs		248		

Total	28612	28157	38392	37809

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602211A - AVIATION TECHNOLOGY**	**47B**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
47B VEH PROP & STRUCT TECH	3999	4285	4175	4242	4287	4319	4414	4511

A. Mission Description and Budget Item Justification: The Vehicle Propulsion and Structures Technology project investigates engine, drive train, and airframe technologies for Department of Defense (DoD) rotorcraft in support of the Future Force, and where feasible, exploits opportunities to enhance Current Force capabilities. The intent is to significantly increase strategic and tactical mobility/deployability, increase reliability, reduce maintenance costs, and increase combat sustainability - all focused on a large reduction in the vehicle's logistics footprint for manned and unmanned rotorcraft. Problems being addressed in propulsion technology include increased fuel efficiency and reduced propulsion systems weight. Technical barriers include temperature limitations for materials, accurate modeling for flow physics, and accurate prediction of propulsion system mechanical behavior. The problem being addressed in structures technology is the inadequacy of current analytical tools to design for acceptable reliability and durability, which leads to heavier, more costly designs, and poor life cycle management. Technical barriers include inadequate structural analysis design tools, inadequate structural dynamics modeling methods for the rotating and fixed system components, inadequate modeling of rotor aeromechanical phenomena, incomplete and non-parametric loads data, and inaccurate inspection and tracking methodologies. Technical solutions are pursued through propulsion and structures research - with a focus on applications towards heavy lift technologies while supporting both manned and unmanned vehicle requirements. Propulsion research is focused on fluid mechanics, high temperature materials, and mechanical behavior for significantly improved small airflow turbine engines, transmissions, gears, bearings, and shaft components for advanced drive trains at significantly reduced weight and cost. This propulsion research supports the goals of the DoD Versatile Advanced Affordable Turbine Engine (VAATE) program. Structures research is focused on the effects of aerodynamic loads, aeroelastic interactions, integrated composites, structural integrity, low cost manufacturing, and crashworthiness that will provide improved rotor and airframe structure subsystems. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL) located at facilities at the NASA Glenn Research Center, Cleveland, OH, and the NASA Langley Research Center, Hampton, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Rotor and Structure Technology: This research devises improved tools and methodologies to more accurately design for acceptable reliability and durability, resulting in platforms that are lighter in weight and less costly to acquire and maintain. In FY06, evaluated reliability, durability, and damage tolerance for tailored and multi-functional composite structures; conducted wind-tunnel tests on a Quad-Tiltrotor model; conducted hover experiments on an advanced active twist rotor system using AH-64A Apache as baseline. In FY07, conduct a wind-tunnel test in cooperation with Bell Helicopter to evaluate a new heavy lift tiltrotor hub design and explore computational prognostic and diagnostic methods to support innovative Army reliability initiatives for the Future Force. In FY08, will investigate aeromechanics design tools to enable the evaluation of new small-scale unmanned air vehicles and micro-scale flapping-wing air vehicles. In FY09, will evaluate new multi-functional structural concepts based on biological systems that are key enablers for future microsystems development.	1555	994	1731	1795
Propulsion & Drive Train Technology: This research investigates high temperature materials, advanced models for flow physics, and improved methods for predicting propulsion system mechanical behavior to increase fuel efficiency and reduce propulsion systems weight. In FY06, completed full-scale rig testing and analysis of the lubrication and thermal behavior of high-speed rotorcraft helical gears to allow operation for 30 minutes after loss-of-lubrication supply; performed rotor-dynamic tests of an oil-free foil air bearing	2444	3280	2444	2447

technology that will reduce engine maintenance costs by 50% and weight by 15%. In support of the Unmanned Air Vehicle Systems (UAV) Technology Demonstration program, validated active stall control technology and evaluated environmental and thermal barrier coatings for silicon nitride turbine nozzles. In FY07, define thermal behavior and lubrication technologies of high speed, high performance gears, including loss of lubricant conditions, using modeling and a representative high-speed gear train; evaluate heavy-fuel concepts for potential fuel cell applications; complete performance and endurance tests of innovative non-contacting air-to-air seal technology for military helicopter and UAV class engines. In support of the UAV Technology Demonstration program, experimentally evaluate a low conductivity thermal barrier coating system for metals. In FY08, will assess and quantify the baseline performance of model-based diagnostic methodology to accurately detect, determine trends, and isolate engine faults and will experimentally evaluate mechanical properties of advanced gear materials to assess their feasibility for use in rotorcraft transmissions. In FY09, will assess the durability of advanced environmental barrier coatings to improve the design of hot section engine components and will experimentally evaluate variable speed transmissions sub-scale components that will enable improvements in rotorcraft maneuverability and noise reduction.				
Small Business Innovative Research/Small Business Technology Transfer Programs		11		
Total	3999	4285	4175	4242

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602270A - EW TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	28746	30972	16411	16605	16782	16911	17283	17663
442	TACTICAL EW TECHNOLOGY	11110	11476	9404	9515	9614	9685	9898	10116
475	ELECTRONIC WARFARE COMPONENT TECHNOLOGIES (CA)	10160	11966						
906	TAC EW TECHNIQUES	7476	7530	7007	7090	7168	7226	7385	7547

A. Mission Description and Budget Item Justification: This program element (PE) researches and investigates electronic warfare (EW) technologies that deny, disrupt, or degrade the enemy's use of the electromagnetic spectrum for offensive or defensive operations, for use in the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. This will be accomplished through the investigation of electronic support measures (ESM), countermeasures against communications systems and networks; the development of sensors used to identify and locate threat forces in an asymmetric environment; and threat warning and electronic countermeasures (ECM) against: munitions sensors and targeting capabilities, missile guidance and targeting systems, and booby traps. Project 442 funds efforts related to research, investigation, and application of electronic warfare technologies to enhance the survivability capabilities of ground combat vehicles, aircraft, and the dismounted Soldier. In addition, this project offers improvements to Current Force EW sensors and ECM systems to further protect high-value ground targets, aircraft, and the Soldier from threat surveillance and tracking systems, imaging systems and advanced RF/EO/IR missiles, artillery, and smart munitions. Improvements to the next generation EW protection sensors augment the classic intelligence, surveillance, and reconnaissance (ISR) sensors by providing multi-functional capabilities for on-board and off-board situational awareness (SA), targeting, and combat identification. Information fusion research addresses sensor correlation, relationship discovery, and management services through use of automated processing, as well as higher level reasoning techniques that support automated combat assessment. Project 906 funds efforts related to research and application of key EW technologies to intercept, locate, and disrupt, current and emerging threat communications and non-communications emitters, to provide vital, quality combat information directly to users in a timely actionable manner in accordance with concepts for Future Force intelligence operations. Specifically, its technologies focus on detecting threat sensors and emitters associated with weapon systems, targeting systems and command, control, communications, computers, and intelligence (C4I) systems and networks.

Efforts in this PE are coordinated with PE 0603270 (EW Technology), PE 0602120 (Sensors and Electronic Survivability), PE 0603772 (Advanced Tactical Computer Science and Sensor Technology), PE 0602783 (Computer and Software Technology), and PE 0602784 (Advanced Concepts and Simulation). Project 475 funds congressional special interest efforts. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is this PE is related to and is fully coordinated with efforts funded in PE 0603270A (EW Technology). Work is performed by the Army Research, Development and Engineering Command, Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602270A - EW TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	29305	19218	16539	16635
Current BES/President's Budget (FY 2008/2009)	28746	30972	16411	16605
Total Adjustments	-559	11754	-128	-30
Congressional Program Reductions		-118		
Congressional Rescissions				
Congressional Increases		12100		
Reprogrammings	-559	-228		
SBIR/STTR Transfer				
Adjustments to Budget Years			-128	-30

Five FY07 congressional adds totaling $11597 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($3355) Silver Fox Unmanned Aerial Vehicle
($1773) Xenon Light Source for Non-Lethal Deterrance
($1246) Battlefld Connectivity, Multi-Level Secure Network
($3690) Dominant MOUT Viewer (DMV)
($1533) Integrated Information Tech Policy Analyses Resch

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602270A - EW TECHNOLOGY**	**442**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
442 TACTICAL EW TECHNOLOGY	11110	11476	9404	9515	9614	9685	9898	10116

A. Mission Description and Budget Item Justification: This project researches, investigates, and applies electronic warfare technologies to enhance the survivability capabilities of ground combat vehicles, aircraft, and the dismounted Soldier. The survivability approach provides detection avoidance through signature management and hit avoidance using warning receivers and electronic countermeasures. This project applies recent advances in radio frequency (RF), infrared (IR), and electro-optical (EO) sensor and jamming sources to detect, locate, deceive, and jam threats, radar directed target acquisition systems, target-tracking sensors, Surface-to-Air Missiles (SAMs), Air-To-Air Missiles (AAMs), top attack weapons, and electronically fuzed munitions. The ability to neutralize booby traps is researched with the goal of embedding the maximum capability in the Current Force, and systems to minimize Future Force vehicle weight, cost, logistics, and fielding. Additionally, this project will research EO technologies and countermeasures technologies against laser-aided and electro-optically directed gun or missile systems. Finally, this project will look at those Electronic Support (ES) technologies used against non-communications signals for targeting and tactical SA.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Networked Electronic Warfare: This effort provides autonomous detection, classification, correlation, and geo-location capability against modern wireless emitters and other threats in battlefield and urban environments. In FY06, evaluated UAV and UGS electronic support measures in a warfighter operational environment that demonstrated real time collection, identification, and location; developed an improved jamming antenna and algorithms; developed situational awareness, traffic analysis, and electronic attack capabilities. In FY07, develop adaptive array processors for use in tactical settings to counter problems associated with multipath, co-channel, and co-site interference that plague current systems. In FY08, will develop digital wideband receiver capability for the detection and denial across the entire threat band; will refine system design and begin integration of complementary capabilities; will integrate wideband antennas into an adaptive array; will integrate algorithms into government off the shelf hardware. In FY09, will integrate capabilities into a net-centric solution that combines jamming and detection/location/neutralization capabilities; will complete algorithm development and fabrication of adaptive processing arrays. Related work is also being accomplished under PE/Project: 62270/906; 63270/K15; 63270/K16.	900	728	2092	1986
Suite of Sense Through the Wall Systems (STTW) for the Future Force: This effort provides users with the ability to detect visibly obscured targets up to the objective stand off distance, operate on the move, accurately geo-locate targets in the presence of clutter with an intuitive user interface. In FY06, conducted lab and user testing of STTW prototypes; utilized experiments to develop tactics, techniques, and procedures and characterize through demonstration urban and complex terrain phenomenology. In FY07, begin development of integrated personnel detection/CWD/CED systems with greater standoff capability and increase probability of detection; conduct lab testing of individual STTW sensors against multiple wall types, and formulate techniques for detection of stationary personnel through multiple wall types; and devaluate and test hand held STTW prototype in the FFW ATD demonstration. Related work is also being	3586	3397		

accomplished under PE/Project: 63772/243.				
Fusion Based Technologies: This effort develops an advanced knowledge generation capability to answer warfighting commanders priority intelligence requirements (PIRs) for the Future Force. These answers provide actionable intelligence enabling timely decision-making by commanders and timely action by Soldiers in the execution of operations. In FY06, used software technologies to represent knowledge needed to logically link multiple, diverse sources of data. In FY07, test an initial toolset to support the brigade intelligence officer in directly building/editing of knowledge required for analysis and inferencing against multiple PIRs in a realistic scenario; create a subset of modeling and simulation (M&S) capabilities needed to support research, development, and testing of Levels 2-5 fusion technologies required for PIR answering. In FY08, will develop expanded set of representations for different types of enemy tactics to handle more complex scenarios including the prediction of locations of specific types of asymmetric attacks using real data; will develop and evaluate in a pre-engagement mode, an initial toolset for evaluating and selecting the most capable and relevant collection assets given PIRs and contextual information; will develop another increment of M&S software that will provide more realistic threat behaviors to support development and testing of representations of threat tactics, plausible explanations of threat activities, and early recognition of threat goals and intentions. Related work is also being accomplished under PE/Project: 62120/H15; 62270/906; 63772/243.	663	3150	3712	
Next Generation Electronic Warfare Technology for Survivability: This effort develops a low cost aircraft self-protection suite that is effective in detecting, disrupting, and defeating small arms, rocket propelled grenades, and man-portable air defense system threats, typical of urban environments. In FY06, evaluated candidate technologies to provide full dimensional protection from electro-optic/ infra-red (EO/IR) guided man-portable weapons systems for ground and airborne platforms; partnered with Navy's Distributed Aperture Infrared Countermeasures (DAIRCM) effort to design, study, and evaluate multiband laser countermeasure; investigated photonic gap multiband optical fibers and multi-wavelength beam switching, beam steering, and pointing devices. In FY07, initiate hardware-in-the-loop EO/IR countermeasure exploitation/evaluation of next generation EO/IR threats; design and develop photonic gap multiband optical fibers, beam switching, beam steering, and pointing devices. In FY08, will integrate/interface DAIRCM multiband laser prototype with optical fibers and pointing/switching/steering technologies and lab demonstrate against next generation threats; will demonstrate next generation countermeasures techniques against advanced EO/IR threats. Related work is also being accomplished under PE/Project: 63270/K16.	2000	1900	3500	
Cueing Sensor: This effort develops low cost infrared sensors that detect rocket propelled grenades, anti-tank guided missiles, and tank fired kinetic energy, and high energy anti-tank rounds and then cue active protection system for Army vehicles. In FY06, developed and demonstrated software algorithms for hardware implementation of the on-the-move frame registration, clutter suppression, specific threat classification for the active protection system cueing sensor; investigated dual band focal plane arrays (FPA) with required array uniformity, operability, sensitivity in the desired spectral bands. In FY07, will develop and optimize threat classification algorithms and signal processing for the active protection system cueing sensor. In FY08, will optimize FPA design; enhance sensor, electronics, and algorithms for on-the-move (OTM) environment. Related work effort is also being accomplished under PE/Project 62120/H15; 63270/K16; 63772/243.	3961	2130	100	100
Multispectral Threat Warning: This effort develops affordable EO/IR countermeasure system concepts with multispectral detectors, multiband laser, advanced countermeasure architectures, and will exploit next generation threats to develop advanced EO/IR countermeasure techniques that will effectively defeat laser guided munitions, surface-to-air, air-to-air, and anti-tank threats. In FY09, will develop new algorithm techniques to exploit signals in background clutter to increase detection, identification, and threat classification capabilities.				4132
Advanced Tactical Electronic Support Measures: This effort supports development of non-communication Electronic Support (ES)				2023

components with multi-functional digital receivers, processors, and software tools that reduce the space, weight, and power requirements for future electronic support systems. In FY09, will begin development of an integrated suite of optimal detection, de-interleaving, and tracking techniques with a goal of full spectrum coverage for all waveform classes in a dense signal environment.				
Low Cost RF Situational Awareness and Countermeasures: This effort provides the electronic countermeasures signal coherency, power, spectral energy efficiency, and jamming capability to protect friendly airborne and surface platforms from the new wideband threat weapon systems that use advanced radar processing techniques. In FY09, will begin development of new hardware and software modules with the capability to neutralize the enemy's ability to locate, classify, and engage our forces with radar based air defense and targeting radars, that will be common to both air and ground platforms.				1274
Small Business Innovative Research/Small Business Technology Transfer Programs		171		
Total	11110	11476	9404	9515

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602270A - EW TECHNOLOGY**	**906**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
906 TAC EW TECHNIQUES	7476	7530	7007	7090	7168	7226	7385	7547

A. Mission Description and Budget Item Justification: This project researches and applies key electronic warfare (EW) technologies to intercept and locate current and emerging threat communications and non-communications emitters to provide vital, quality combat information directly to users in a timely actionable manner in accordance with concepts for Future Force intelligence operations. This project contributes to the commanders ability to see the enemy, both as a unit and as part of a complex, adaptive organization, allowing a "See First, Understand First, Act First" standard of operations. This project investigates radio frequency (RF) collection and mapping technologies to offer real time emitter detection, location, and identification. Efforts include adding an autonomous RF collection capability and algorithms into tactical software defined radios to detect, locate and display enemy RF emissions. It also evolves electronic attack (EA) components into smaller, lower power, lightweight, common modules that counter modern threat Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems. In addition, this project enables a remote capability to disrupt, deny, or destroy threat communication signals. Other research areas include fusion (automated assimilation and synthesis) of battlefield intelligence data to enable interpretation of current and future enemy activities and allowing development of courses of action in time to act decisively and in a pre-emptive manner.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this program element (PE) is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center, Ft. Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Networked Electronic Warfare: This effort provides autonomous detection, classification, correlation, and geo-location capability against modern wireless emitters and other threats in battlefield and urban environments. In FY06, developed electronic support for the Future Force sensor model; integrated electronic support measure (ESM)/signals intelligence (SIGINT) algorithms into ground sensor systems; developed and investigated adaptive/smart antenna processing techniques to enhance baseline information operations system; investigated novel radio frequency probing and other techniques for detection, location, and selective neutralization of triggering devices. In FY07, collect target vulnerability data, continue development of adaptive array processors for use in a tactical setting to counter problems associated with multipath, co-channel, and co-site interference, and to provide a precise geolocation capability; develop more effective techniques using broad range of target focused information operations (IO) algorithms based on individual target transmission parameters rather than brute force techniques; begin development of effects based IO deception techniques to influence a potential targets plan of action. In FY08, will continue algorithm development for an expanded range of potential targets, as well as software development for data thinning and nodal analysis applications; will expand algorithms development for larger range of targets; will continue deception and effects algorithm development. In FY09, will investigate and develop techniques to engage emergent communications technologies for inclusion into IO techniques database; will refine IO techniques database for access and use by other users including Joint Service and other members of intelligence community. Related work is also being accomplished under PE/Project: 62270/442; 63270/K15/K16.	6584	6418	7007	4100
Fusion Based Technologies: This effort develops an advanced knowledge generation capability to answer warfighting commanders priority intelligence requirements (PIR) for the Future Force. These answers provide actionable intelligence enabling timely decision-	892	1073		2990

making by commanders and timely action by Soldiers in the execution of operations. In FY06, conducted experiments and evaluations to show software architectural capabilities to rapidly develop and maintain multiple interpretations and associated confidence levels to answer commander's priority intelligence requirements; identified requirements and construct initial information agents to support intelligence retrieval of information from diverse data sources. In FY07, develop modeling and simulation tools to support identification and tracking of aggregates, and simpler cases of inferring enemy objectives. In FY09, will develop final set of representations for different types of enemy tactics to handle more complex and asymmetric behaviors such as ambushes, vehicle-borne explosive devices, and sniper attacks; will demonstrate capabilities to automatically identify and link human-specified critical entities and activities to PIRs, and reveal emerging actionable intelligence; will develop and demonstrate an intelligence, surveillance, and reconnaissance planning/re-planning toolset with capabilities to function in an operations execution mode for evaluating and selecting the most capable and relevant collection assets given PIRs and contextual information. Related work is also being accomplished under PE/Project: 62120/H15; 62270/442; & 63772/243.				
Small Business Innovative Research/Small Business Technology Transfer Programs		39		
Total	7476	7530	7007	7090

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602303A - MISSILE TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	75149	77276	53038	48324	48310	49211	43384	44284
214	MISSILE TECHNOLOGY	40560	47320	53038	48324	48310	49211	43384	44284
223	AERO-PROPULSION TECHNOLOGY	11022	10977						
G02	Army Hypersonics Applied Research	2000	11462						
G04	AIR DEFENSE TECHNOLOGIES (CA)	4697	1632						
G05	MISSILE TECHNOLOGY INITIATIVES (CA)	13515	4253						
G06	UNMANNED SYSTEMS TECHNOLOGIES (CA)	3355	1632						

A. Mission Description and Budget Item Justification: This applied research program element (PE) investigates, designs, and develops advanced component technologies for missiles, rockets, and launch systems for use in the Future Modular Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The overall objectives of the PE are to investigate and develop technologies which increase the lethality and effectiveness of tactical missiles and guided interceptors under adverse battlefield conditions, enhance the survivability of launch systems, increase kill probabilities against diverse targets, and provide advanced simulation and virtual prototyping analysis tools. A major cross-cutting theme is developing missile technologies that are smaller, lighter weight, and more affordable. Major technology areas include missile guidance systems, multi-spectral seekers, high fidelity simulations, missile aerodynamics and structures, missile propulsion including efforts to help solve the insensitive munitions requirements for missiles, hypersonic/hypervelocity missile efforts, and the development of a common high-gravitational force (high-G), low cost, Micro Electro-Mechanical System (MEMS) Inertial Measurement Unit (IMU). The major efforts inlcude the high-G MEMS IMU program (which is designing and developing affordable, reliable precision guidance components for missiles and guns at a significantly lower unit cost and smaller size than current systems) and integrating a GPS receiver with the IMU in a deeply-integrated guidance and navigation unit (DIGNU). The performance and small packaging goals will enable the components to meet the requirements of 90 percent of Department of Defense guided munitions and missiles. The high-G MEMS IMU program is a collaborative project between the US Army Armament Research, Development, and Engineering Center (ARDEC), and US Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC). The MEMS IMU effort is funded by a combination of applied research funding, in this PE, and manufacturing technology funding, in PE 0708045A (Industrial Preparedness). Another major thrust in the PE is to investigate and develop small, lightweight force protection technologies needed to cost effectively counter the rocket, artillery, and mortar (RAM) threats to the Current and Future Force. The Extended Area Protection and Survivability (EAPS) program investigates and develops the interceptor and fire control technologies necessary to provide the Future Force with an active defense against RAM. In addition, the Smaller, Lighter, Cheaper (SLC) Tactical Missiles effort explores technologies to reduce the cost and logistics burden of precision munitions. This program's goal is to reduce the cost per kill of precision guided missiles and munitions, through the innovative application of technology in concert with more efficient production and integration processes. An important thrust is developing new approaches to ensure future tactical missiles can meet insensitive munition (IM) requirements. This helps insure the safety of Soldiers from unintentional detonation of munitions and missiles. The Army Hypersonics Applied Research program explores and develops the critical technologies required for expendable hypersonic/hypervelocity missiles and hypersonic threats. This PE contains no duplication with any effort within the Military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal,

AL.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602303A - MISSILE TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	90712	59439	54951	43410
Current BES/President's Budget (FY 2008/2009)	75149	77276	53038	48324
Total Adjustments	-15563	17837	-1913	4914
Congressional Program Reductions		-295		
Congressional Rescissions				
Congressional Increases		18700		
Reprogrammings	-15563	-568		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1913	4914

FY06 funds decreased to support higher priority efforts.
FY09 funds increased to support next generation tactical missile technology.
Nine FY07 congressional adds totaling $17924 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($2875) MARIAH II Hypersonic Wind Tunnel Dev Program
($1534) LENS X Hypervelocity Ground Testing
($6230) Missile Aero-Propulsion Computer System Mod
($1582) Enhanced Area Protection & Survivability
($1247) Jam Resistent Technology for INS/GPS Precision
($958) Materials Applications Research Center (UAB)
($958) Nanotechnology Research with AMRDEC
($958) Novel Lgtwt Armor Material f/Insensitive Munitions
($1582) Unmanned Systems Initiative at AMRDEC

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602303A - MISSILE TECHNOLOGY**	**214**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
214 MISSILE TECHNOLOGY	40560	47320	53038	48324	48310	49211	43384	44284

A. Mission Description and Budget Item Justification: This project focuses on missile and rocket technologies that support lightweight, highly lethal weapons concepts with greatly reduced logistics requirements for Future Modular Force and, where feasible, exploits opportunities to enhance Current Force capabilities. Major technology areas investigated are missile guidance systems; air defense target acquisition systems; multi-spectral seekers; high-fidelity simulations; missile aerodynamics and structures; and missile propulsion including research to help solve the insensitive-munitions requirements. A theme embedded throughout the efforts in this project is developing smaller, lighter, and cheaper (SLC) missile technology to reduce the cost and logistics burden of precision munitions. Program objectives are to enhance the survivability of launch systems, provide greater effectiveness under adverse battlefield conditions, increase kill probabilities against diverse targets, and provide advanced simulation and virtual prototyping analysis tools. A major effort in this project is to design and develop the high-gravitational force (high-G), low cost Micro Electro-Mechanical Systems (MEMS) Inertial Measurement Unit (IMU), and to design, develop, and integrate a GPS receiver with the IMU in a deeply-integrated guidance and navigation unit (DIGNU). The Army is the service lead in the investigation of low-cost MEMS IMUs capable of supporting precision guidance requirements of Department of Defense's missile and gun launched precision munitions programs. The MEMS IMU and DIGNU efforts are funded by a combination of applied research funding, in this PE, and manufacturing technology funding, in PE 0708045A (Industrial Preparedness.) This is a collaborative program with the US Army Armament Research, Development, and Engineering Center at Picatinny Arsenal. The DIGNU effort develops and demonstrates an Inertial Sensor Assembly (ISA) with the same 1.0 deg/hr, and greater than 20,000G survivability requirements of the initial IMU program with an additional "deeply-integrated" or "deeply-coupled" Selective Availability and Anti-Spoofing Module (SAASM)-based GPS military receiver. The DIGNU incorporates a single microprocessor architecture and integrated hardware and software anti-jam (AJ) capability. The Smaller, Lighter, Cheaper (SLC) Tactical Missile effort focuses on technology to reduce the cost and logistics burden of precision munitions. This program's goal is to reduce the cost per kill of precision guided missiles and munitions, through the innovative application of technology in concert with more efficient production and integration processes. The SLC effort includes a partnership with the Defense Advanced Research Projects Agency (DARPA) on the design and proof of principle of the Close Combat Lethal Recon (CCLR) system, a 5 lb, Soldier-launched, loitering munition (two minute duration/two km radius) for use over and around buildings and other obstructions in non-line-of-sight environments. The DARPA portion of the CCLR effort is funded under PE 0603766E. Guidance Electronics Miniaturization and Structronics (GEMS), is working to significantly reduce the size, weight, and cost of guidance electronics. GEMS incorporates commercial electronics miniaturization (die stacking, wafer thinning, etc.) and seeks to develop technologies to use the electronics substrate as the chassis, wiring harness, and printed wiring board for the electronics. Each of these elements are being incorporated into a series of Integrated Guidance Units (IGU) which consist of a guidance computer and an inertial measurement unit. An important thrust is developing new approaches to ensure future tactical missiles can meet insensitive munition (IM) requirements. This helps insure the safety of Soldiers from unintentional detonation of munitions and missiles. Solid propellant formulations along with improved, high performance rocket case materials, and rupture mechanisms are being investigated. Also included in this project is the Extended Area Protection and Survivability (EAPS) program, which develops the technology necessary to provide the Future Force with an active defense capability against rockets, artillery, and mortars (RAM). Major products of this PE generally transition to PE 0603313A (Missile and Rocket Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan. Work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009

High-G Micro Electro-Mechanical Systems (MEMS) Inertial Measurement Unit (IMU): In FY06, used advanced die packaging techniques to support miniaturization of IMUs to less than four cubic inches volume; incorporated out-of-plane gyros and in-plane accelerometers, and integrated MEMS packaging techniques to get the smallest possible IMU volume; developed die attach methods and a new design process for Application-Specific Integrated Circuits (ASICs); and developed a new internal isolator. Repackaged the gyro, accelerometer, and their respective digital electronics to improve signal isolation. Performed test and evaluation on the preliminary Phase 3 IMUs. In addition, redesigned and evaluated the vibration isolation system for the modified mass and diameter to address the 20,000G. launch environment. In FY07, continue to investigate methods to get tactical grade performance across all environments. In addition, increase built-in-test capabilities, iterate IMU design to get improved performance under vibration, iterate gyro, and accelerometer design to handle canard shock, improve processes to increase sensor yields, and increase automation of test and calibration capabilities. In FY08, perform bench testing and a missile and munition flight test of the final Phase 3 IMUs and analyze and evaluate their performance.	12290	4903	3100	
High-G Micro Electro-Mechanical Systems (MEMS) Deeply Integrated Guidance and Navigation Unit (DIGNU): The DIGNU is being developed in phases with performance being increased and size being decreased for each successive phase. In FY06, tested DIGNU Phase 2s to the following parameters: gyro bias less than 20 deg/hr, volume less than 14 cubic inches, acceleration bias less than four milli-Gs, and gun-hardened to 15,500G. Performed field tests on the DIGNU Phase 2 units to determine GPS/INS/anti-jam capability; refined and further miniaturized internal anti-jam capability; tested G-operational requirements. Evaluated and refined the deep integration algorithms and planned the redesign for DIGNU Phase 3 electronics miniaturization to improve performance and to address performance issues identified during live field tests. In FY07, design and develop a partial system-on-a-chip (SOC) to give DIGNU Phase 3 the smallest volume. Miniaturize GPS receiver and AJ hardware, add frequency excision AJ, miniaturize SAASM, and migrate to an improved microprocessor. Perform test and evaluation on the DIGNU Phase 3s. In FY08, will perform field tests and laboratory characterization on DIGNU Phase 3s including anti-jam capability; will further miniaturize the anti-jam module. The DIGNU Phase 3s will be tested against the following parameters: gyro bias less than one deg/hr, volume less than six cubic inches, acceleration bias less than one milli-G, greater than 90 db J-to-S and gun-hardened to 20,000G. In FY09, test and evaluate anti-jam module with GPS receiver and deep integration (DI) in non-roll and roll environments. Test DI algorithms and anti-jam module with various antenna configurations. Test different platforms, dynamics, and mission envelopes. Test flight scenarios with hardware-in-the-loop. Conduct government test and evaluation on inertial sensor, deep integration algorithms, DIGNU anti-jam capability, GPS receiver, and interaction of all these pieces.	5400	5104	5731	6630
Smaller, Lighter, Cheaper (SLC) Tactical Missiles: SLC reduces precision munition cost per kill and logistics burden via innovative technology application. In FY06, conducted industry surveys of seeker and guidance electronics unit (GEU) components. Completed trade study of system-in-a-package technology to miniaturize seeker electronics by 8 percent (transitioned to improved Precision Attack Missile (iPAM)). Completed feasibility analysis of increasing iPAM range from 2.5 km to 4.0 km. Completed electronics development for TOW Alternate Fuze (TAF) and transitioned to prime. TAF applicable to 2.75 inch rocket and M72. Completed assessment and initial design of multi-purpose warhead (MPW) that defeats armor/fortified structures/ personnel, is IM compliant and scalable for TOW/Javelin/Hellfire/PAM. MPW will transition to PM CCWS. In FY07, will complete MPW design and test against each target type. Initiate design of miniaturized electronics for automated fuze timing to maximize lethality against different target sets without launcher system modifications. Will transition to PM CCWS and other systems with MPW. Complete miniaturized GEU initial design for Close Combat Lethal Recon (CCLR), Javelin Block II GEU, and Command Launch Unit (CLU). Support DARPA development of CCLR system (5 lb Soldier-launched, loitering munition) including initial warhead, safe and arm (S&A) design, trade study on adding uncooled non-gimbaled IR seeker, and assessment of handheld viewer functionality. In FY08, will finalize design, fabricate, and test miniaturized GEU. Will complete design of uncooled non-gimbaled IR seeker, if trades show feasibility. Will finalize design, develop, and fabricate CCLR warhead and S&A. In FY09, will leverage latest in nanotechnology and electronics packaging to achieve small, light, missile form	1500	5900	7000	5500

factors to meet urban and emerging threats. Will conduct trades, build prototype designs. Test small, low cost, ungimbaled seeker/sensor system.				
Missile Guidance Systems and Seeker Technology: In FY06, integrated uncooled infrared (IR) prototype hardware with advanced guidance and control signal processing techniques to provide lower cost IR seekers; demonstrated RF and optical phase shifters for Phased Arrays for Tactical Seekers (PATS) via laboratory tests (PATS will eliminate the moving parts in seekers, increasing affordability). Lab tested damaging laser infrared-counter measure (IRCM) threats to harden optical components. Spiraled stackable substrates and chip-scale packaging into Block 1 Integrated Guidance Unit (IGU). Built, tested, compared to baseline IGU design performance. Stackable IGU substrates miniaturize electronics to enable insertion of guidance packages for missiles that are too small to include guidance. In FY07, evaluate uncooled IR concepts and demonstrate prototype configurations. Fabricate, and test passive phased sub-array from optical phase shifters and initiate transition to provide lower cost IR seekers. Integrate countermeasure algorithms and optics in a seeker and perform hardware-in-the-loop testing. Spiral in die stacking/thinning into Block 2 IGU; build, test, and compare to IGU baseline performance. Transition new vehicle target algorithm to Non-Line-of-Sight Launch System prime for Precision Attack Missile (PAM) target tracker. In FY08, spiral upgrade vehicle target algorithm and initiate Human Tracking Technology (HTT) development for anti-personnel weapon systems. Transition initial HTT to the Close Combat Lethal Recon (CCLR) system. Build and test PATS sub-arrays. In FY09, will transition upgraded HTT to CCLR. Incorporate physics-based versatile/accurate models of threat targets and environments simulation scenes for enhanced algorithm development, tracker, and ATA/R optimization. Fabricate a prototype novel seeker with strap-down electronically stabilized imager. Complete captive flight tests of an imaging radar seeker using low cost hardware.	10545	12984	14155	12411
High Fidelity System Level Simulations and Aerodynamics: The use of advanced simulation and aerodynamics tools promises to reduce size, lighten the weight, and reduce cost in missile systems. In FY06, applied laser radar (LADAR) target signature modeling to specific targets and backgrounds. Completed the design of real-time simulation control software. Extended aerodynamic predictive techniques by validation with detailed measurements to understand the effects and performance of new missile aerodynamic shapes in missile designs. In FY07, complete a hybrid patch approach for clutter statistics in order to progress simulation technology toward a fully predictive scene generation capability to provide accurate and high fidelity simulated scenes for missile seeker simulations. Extend aerodynamic predictive techniques by validation of Navier-Stokes equation solvers with detailed measurements of supersonic, reacting airflows. In FY08, will develop techniques for target modeling applicable to coherent Frequency Modulated Continuous Wave (FMCW) LADARs. PC-based real-time scene generation will be applied to all passive IR simulation capabilities. HWIL simulation control software will be installed and tested in a range of simulation capabilities and will extend aerodynamic prediction techniques for evaluating novel aerodynamic shapes. In FY09, will formalize LADAR target signature modeling techniques into standard procedures. Will extend HWIL simulation control software to improve user capabilities and extend aerodynamic prediction techniques to address fully turbulent, short correlation length, unsteady flows.	2855	2780	3584	3354
Smart, Stealthy, Smokeless Missile Propulsion, Smart Structures and Enhanced Lethality: In FY06, designed, fabricated, and static tested integrated spring assembly actuator and in variable-area-nozzle (VAN) concept in a system configuration for variable thrust rocket motors. Integrated a compact shaped charge warhead with enhanced fragmentation design features into a tandem system concept. Demonstrated the addition of thermobaric explosive to enhanced lethality of warhead sub-system. In FY07, complete testing of VAN and update design concepts and subsystem integration test in order to demonstrate projected increase in performance and decrease in sensitivity of the motor. Demonstrate a compact combined effects warhead which has been integrated into a tandem warhead missile system against a state-of-the-art target set. Investigate and evaluate the integration of warhead concepts into tactical missile systems. In FY08, will investigate new propellant formulations that operate efficiently over extreme temperature ranges. Demonstrate a fully integrated dynamic Hardened Combined Effects Warhead with enhanced blast and fragmentation characteristics against heavy armor and MOUT targets. Design,	4870	6226	8668	7329

fabricate, and test distributed thermal ignition concept and grain surface energetic coating schemes in order to improve engagement timeline and accuracy through prompt and repeatable rocket motor ignition with reasonable cost, weight, and volume. This is needed for Active Protection Systems and Area Protection Systems that operate on very short timelines. In FY09, will formulate propellant candidates designed to operate efficiently in extreme temperature ranges. Will evaluate multi-mode warhead characteristics using multi-point initiation concepts to control the energy deposited on the target. Will perform initial investigation and analysis of variable yield warhead/explosive technologies to vary the effects on target and minimize collateral damage.				
Insensitive Munitions (IM) Research: In FY06, conducted solid propellant formulation and characterization efforts in both minimum smoke and high performance propellants (AP/Al) as well as evaluated lightweight barrier concepts. In FY07, will evaluate existing and new energetic ingredients for beneficial insensitive munition characteristics. Will conduct formulations studies for emerging oxidizers, thermal additives, and nitramine replacements. Will apply emerging materials/concepts to canister/case design. In FY08, conduct ballistic/aging evaluation on new formulations. Will develop integrated passive venting designs and characterize performance of lightweight barrier concept to impact and thermal threats. In FY09, demonstrate mitigation of IM response to impact threats of a high performance motor through the use of lightweight barrier. Demonstrate improved IM response of a minimum smoke motor with new propellant formulation and integrated venting to bullet impact, fragment impact, fast cook off, and slow cook off environments. Demonstrate improved IM response to thermal threats of high performance motor with new propellant formulation and integrated venting.	1100	1300	1100	1100
Defense Against Rockets, Artillery and Mortars (RAM) - Interceptor Development: In FY06, began the design and development of critical supporting component interceptor technologies, including lethal mechanisms, propulsion and low cost guidance, and control mechanisms. Conducted a series of lethality tests establishing fragment size, mass, and shape required to defeat the RAM threat. Built and tested prototype forward firing warhead. Developed and began validating lethality assessment models and simulations. Began fabrication of miniature interceptor infrared and radio frequency breadboard sensors. Began fabrication of miniature dual axis canard control system, and began development of physics based digital system level simulations. In FY07, will complete designs and will fabricate and test propulsion subsystem. Will complete fabrication, and begin testing of the interceptor sensors and control systems. Will update system simulations and develop interceptor performance specification. In FY08, will complete testing of sensors and control systems, update system simulations, develop integrated interceptor design, and begin integrating prototype component technologies. In FY09, will fully integrate component technologies into prototype interceptors and perform hardware-in-the-loop testing. Will incorporate the results of all testing into update-error budgets and system level simulations. Will exercise the simulations to evaluate interceptor performance in expected operational scenarios. This project transitions into Defense Against RAM efforts in 0603313A Project 263.	1000	4000	9700	7000
Defense Against Rockets, Artillery and Mortars (RAM) - Fire Control and Systems Architecture: In FY06, defined fire control components, and the required integration of the fire control and interceptor technologies into a robust system architecture. Developed requirements for long range and short range surveillance sensors, developed requirements for the fire control sensors, and developed and evaluated impact point prediction algorithms. In FY07, begin fabrication and bench and field testing of critical short range surveillance and fire control sensor technologies. Transition these technologies to PE 0603313A (Missile and Rocket Advanced Technology) D704.	1000	3263		
Multi-Role Missile Engine and Missile Component Design: In FY09, this effort will gather breakthrough technologies developed in PE 0602303A (Missile Technology) projects in missile propulsion, power, data link, processing, seekers, actuators/controls, navigation, and warheads to develop the next generation of Army missile concepts. This next generation of missiles will be characterized by smaller diameters and shorter lengths building on technologies being developed for use in guided interceptors. Other characteristics will include low-cost multi-mode seekers generally only associated with precision attack munitions, micro electro-mechanical systems inertial measurement units complimentary to both missiles and precision guided munitions, miniaturized deeply-integrated guidance and navigation units, miniaturized electronic units, extreme temperature range insensitive propellants, robust data links, and anti-jamming				5000

capability. Lethality will be maintained while integrating these components into paradigm-shifting missile designs.				
Small Business Innovative Research/Small Business Technology Transfer Programs		860		
Total	40560	47320	53038	48324

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602307A - ADVANCED WEAPONS TECHNOLOGY**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	34485	24061	19342	19791	19638	20362	20810	21268
042	HIGH ENERGY LASER TECHNOLOGY	19054	19216	19342	19791	19638	20362	20810	21268
NA5	Advanced Weapons Components (CA)	15431	4845						

A. Mission Description and Budget Item Justification: This applied research program element (PE) investigates advanced technologies for Future Force High Energy Laser (HEL) weapons technology, and, where feasible, exploits opportunities to enhance Current Force capabilities. The major effort under this PE is the development of a multi-hundred kilowatt (kW) Solid State Laser (SSL) laboratory demonstrator that can be integrated into a HEL weapon system to provide increased ground platform-based lethality. HEL systems have the potential to address the following identified Army capability gaps: 1) Defeat In-Flight Projectiles such as rockets, artillery, mortars, anti-tank guided missiles, and man-portable surface-to-air missiles; 2) Ultra-Precision Strike with little to no collateral damage; 3) Disruption of Electro-Optical (EO) and Infra-Red (IR) sensors; and 4) Neutralizing mines and other ordnance from a stand-off distance. HELs are expected to complement conventional offensive and defensive weapons at a lower cost-per-shot than current systems. At weapon system power levels of greater than 100kW, SSL technology has the potential to enhance survivability by addressing the capability gaps identified above. This SSL technology effort addresses technical issues such as high average power output from compact and more efficient lasers; precision optical pointing and tracking; laser effects degradation due to atmospheric effects; lethality against a variety of targets; and effectiveness against low-cost laser countermeasures. The multi-hundred kilowatt laser and additional HEL technology components will be refined and upgraded to transition into an integrated SSL weapons system demonstrator that will be developed in PE 0603004A (Weapons and Munitions Advanced Technology) Project L96. Project NA5 funds congressional special interest items. Work in this PE is related to, and fully coordinated with, efforts in PE 0602890F and PE 0603924F (High Energy Laser Joint Technology Office), PE 0605605A (DoD High Energy Laser Systems Test Facility), and PE 0603004 (Weapons and Munitions Advanced Technology) Project L96. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the U.S. Army Space and Missile Defense Command (SMDC), in Huntsville, AL, and the High Energy Laser Systems Test Facility, White Sands Missile Range, NM.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602307A - ADVANCED WEAPONS TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	36233	19430	19492	19826
Current BES/President's Budget (FY 2008/2009)	34485	24061	19342	19791
Total Adjustments	-1748	4631	-150	-35
Congressional Program Reductions		-92		
Congressional Rescissions				
Congressional Increases		4900		
Reprogrammings	-1748	-177		
SBIR/STTR Transfer				
Adjustments to Budget Years			-150	-35

One FY07 congressional add totaling $4900 was added to this PE: Army Missile and Space Technology Initiative

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602307A - ADVANCED WEAPONS TECHNOLOGY**	**042**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
042 HIGH ENERGY LASER TECHNOLOGY	19054	19216	19342	19791	19638	20362	20810	21268

A. Mission Description and Budget Item Justification: This applied research project investigates advanced technologies for Future Force High Energy Laser (HEL) weapons technology, and, where feasible, exploits opportunities to enhance Current Force capabilities. The major effort under this project is the development of multi-hundred kilowatt (kW) Solid State Laser (SSL) laboratory technologies that can be integrated into a HEL weapon system to provide increased ground platform-based lethality. This SSL technology effort addresses technical issues such as high average power output from compact and more efficient lasers; precision optical pointing and tracking; laser effects degradation due to atmospheric effects; lethality against a variety of targets; and effectiveness against low-cost laser countermeasures. The multi-hundred kilowatt laser and additional HEL technology components will be refined and upgraded to transition into an integrated SSL weapons system demonstrator that will be developed in PE 0603004A/L96. Work in this project is related to, and fully coordinated with, efforts in PE 0602890F and PE 0603924F (High Energy Laser Joint Technology Office), PE 0605605A DOD High Energy Laser Systems Test Facility (HELSTF), and to PE 0603004 (Weapons and Munitions Advanced Technology) Project L96. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the US Army Space and Missile Defense Command (SMDC), in Huntsville, AL, and the High Energy Laser Systems Test Facility (HELSTF), White Sands Missile Range, NM.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Solid State Laser Effects: In FY06, Laser Lethality and Propagation Assessments initiated laser propagation and lethality studies in different environments at tactical ranges both at HELSTF and other test facilities using appropriate lasers. Developed test plan for utilizing existing assets for conducting low power propagation studies. Laser Modeling and Simulation initiated the development and validation of performance and propagation models for Solid State Lasers in a tactical environment. In FY07, Laser Lethality and Propagation Assessments conduct lethality assessments on an expanded target set representative of identified capability gaps. Laser Modeling and Simulation will begin integration of validated models into approved Army war-gaming models. In FY08, perform lethality studies of advanced fuses of candidate Rockets, Artillery, and Mortar (RAM) targets. In FY09, perform lethality studies of representative rockets.	1165	1437	1500	1500
Solid State Laser (SSL) Development, Phase 3 - 100kW: The goal of this Joint High Power Solid State Laser (JHPSSL) Phase 3 project is to develop and demonstrate alternative 100-kW-class, near-diffraction-limited diode-pumped solid-state lasers that have architectures that are favorable in terms of size, weight, efficiency, affordability, reliability, maintainability, supportability, environmental acceptability (air, land, and maritime), and ruggedness for tactical weapon applications. In FY06, initiated development of two 100kW SSL. Procured long lead items and began integration of components into subsystems that form the basis of 100kW laboratory laser devices that meet the JHPSSL Program Phase 3 performance goals for power, beam quality, run time, and efficiency. In FY07, fabricate remaining components, integrate subsystems into laser breadboards, and conduct preliminary performance tests towards integration of two complete 100kW SSL breadboards. In FY08, will continue laboratory performance testing and increase power output in order to characterize laser characteristics and achieve medium power (25 to 50 kW) laser output. In FY09, will complete integration and testing in order to achieve desired performance for evaluation and selection of the most promising laser and component technologies for the High Energy Laser Technology Demonstrator (HELTD).	16724	17101	17842	18291

Space Application Concepts: In FY06, complete Joint Warfighting Space/Tactical Satellite (JWS/TacSat) cooperative Hyperspectral Imagery (HSI) payload development with Air Force Research Laboratory for JWS demonstration to validate Army Space Intelligence and reconnaissance tactical needs. This activity will be transferred to PE 0603006A (Command, Control, Communications Advanced Technology) beginning in FY07.	1165			
Small Business Innovative Research/Small Business Technology Transfer Programs		678		
Total	19054	19216	19342	19791

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	25848	25001	16654	17131	17691	18058	18461	18872
C90	Advanced Distributed Simulation	9336	10054	10850	11166	11541	11780	12039	12304
D01	PHOTONICS RESEARCH	3258	3560						
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	5202	5948	5804	5965	6150	6278	6422	6568
D14	Advanced Modeling and Simulation Initiatives (CA)	6710	5439						
HB4	IMMERSIVE ENVIRONMENT APPLIED RSCH INITIATIVE (CA)	1342							

A. Mission Description and Budget Item Justification: This program element funds applied research in modeling and simulation technologies for application to training and evaluation of the Future Force (FF) and the Current Force. It establishes standards, architecture, and interfaces essential to realizing the Army vision of creating a verified, validated, and accredited synthetic "electronic battlefield" environment as an acquisition evaluation, training, and mission planning and rehearsal tool. The creation of this electronic battlefield environment requires advanced distributed simulation technologies, such as networking of models, complex data interchange, and collaborative training. The application of this electronic battlefield environment to support training requires applied research in modeling, simulation, and training technologies. This environment helps the Army to investigate and refine new warfighting concepts, including the next generation of tactics, doctrine, training techniques, soldier support systems, and system upgrades. Project C90 focuses on advancing technologies required for real time interactive linking within and among constructive, virtual, and live simulation and training by refining technologies for advanced distributed interactive simulation. Project D02 provides applied research in immersive training at the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California, to leverage the entertainment and game industries in advancing the Army's modeling and simulation technology and applications. This program ensures the transition of the research results of the ICT into the Army technology base and future Army training products. Projects D01 and D14 fund congressional special interest items. Work in this program element is related to and fully coordinated with efforts in PE 0603015A, Project S28 (Institute for Creative Technologies (ICT) - Advanced Technology Development) and PE 0603015A, Project S29 (Modeling and Simulation - Advanced Technology Development); PE0601104A, Project J08 (Institute for Creative Technology), PE0602716A, Project H70 (Human Factor Engineering Systems Development), PE0603007A, Project 792 (Personnel Performance and Training) and PE0602787, Project 874 (Medical Technology). This work does not duplicate an effort within the military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Research, Development, and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	27416	16181	17083	17462
Current BES/President's Budget (FY 2008/2009)	25848	25001	16654	17131
Total Adjustments	-1568	8820	-429	-331
Congressional Program Reductions		-95		
Congressional Rescissions				
Congressional Increases		9100		
Reprogrammings	-1568	-185		
SBIR/STTR Transfer				
Adjustments to Budget Years			-429	-331

Three FY07 congressional adds totaling $8721 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($3450) Photonics Research - Congressional Increase
($958) Automated Man-In-Simulant-Test (MIST)
($4313) Surveillance and Targeting Robot Platform (Red OWL)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**	**C90**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
C90 Advanced Distributed Simulation	9336	10054	10850	11166	11541	11780	12039	12304

A. Mission Description and Budget Item Justification: This project develops enabling technologies for advancing distributed interactive simulation in synthetic environments such as networking of models, complex data interchange, and collaborative training. It enhances the use of modeling and simulation as an acquisition and training evaluation tool by providing that ability to create a virtual representation of a lethal combined arms environment with the warfighter-in-the-loop that constructive (event driven) simulation cannot provide. Such environments permit the evaluation of new system concepts, tactics, and doctrine, and test requirements with a warfighter-in-the-loop throughout the acquisition life cycle at a reduced cost and in less time. This project develops technologies to support embedded simulation, intelligent forces representation, rapid and cost-effective generation of synthetic environments, simulation interface and linkage technologies, and complex data modeling. This project leverages and coordinates with work at the Army Research Institute, the Army Research Laboratory, and the Medical Research Materiel Command. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Research, Development, and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Live, Virtual, Constructive (LVC) Simulations: In FY06, established standard process and tools for development of high-resolution urban virtual environments that are common to training, mission planning/rehearsal, and testing applications. Increased interoperability of multi-service virtual simulations networked with live systems in training environments. Demonstrated components with inertial sensor and software optimizing sensor fusion for more robust navigation during live training exercises and increased accuracy for simulated tactical engagement training. Developed multiple graphical processor unit (GPU) cluster architecture using algorithms from GPU coprocessor research and developed concept for using GPU coprocessors in training systems. In FY07, extend research to rapidly create urban environments for training, mission planning, and rehearsal. Design navigation software, embedded training tracking devices and Soldier system prototypes to provide deployable LVC embedded training. Develop tools to integrate large constructive simulations using multiple GPUs to increase the computational output for the simulation of highly complex urban environments. In FY08, will research database scaling and distribution to support embedded training on small footprint computers of current force vehicles. Will integrate embedded training databases and tracking systems into dismounted Soldier embedded training prototype to support LCV embedded training. Will research and conduct lab and field demos of small, accurate, low cost, low power tactical engagement simulation sensors to demonstrate LVC embedded training functionality on dismounted Solider systems. In FY09, will integrate live sensors and a virtual/constructive mission rehearsal capability on a current Soldier system prototype. Will conduct a field demonstration of integrated LVC embedded training to mitigate risks associated with weight, size and battery life limitations of Soldier systems.	3008	2871	3147	3383
Modeling and Simulation Training Technologies: In FY06, evaluated patient simulator use during military training exercises. Developed computer-based simulation environment to support Combat Casualty Care training for time when patient simulator use is not practical. Evaluated a field capable embedded training system integrated with a Future Force (FF) surrogate to evaluate deployable collective training and distributed after-action review technologies for the dismounted Soldiers. Designed human wearable augmented reality training technologies and developed tools to evaluate mixed human-intelligent agent team performance. In FY07, design new severe	3276	3225	3744	3719

trauma simulation capabilities including advances in the look, feel, and smell of simulated soft tissue, orthopedic, and organ casualties that support combat medic training with realistic battlefield injuries. Develop low cost embedded training devices for use on Soldier systems. Design intelligent and adaptive behaviors to represent autonomous systems and enhance the human-intelligent agent team training. In FY08, will complete prototype patient trauma simulations in collaboration with Army medical trauma research and with advances in material sciences to include realistic skin, flesh, blood, bone, fluids, and organs, sensor technologies, and simulated fluid loss technologies. Will research the use of man-worn immersive systems and reconfigurable mobile immersive systems and will conduct experiments using locomotion and man-worn systems for immersive environments. Will conduct experiments using autonomous systems to enhance the human intelligent agent team training. In FY09, will test prototypes in the current program of instruction to assess Army medical training effectiveness. Will research and develop a mobile immersive training environment that includes the appropriate mix of man-worn systems, locomotion systems and the ability to control autonomous agents for team training.				
Collaborative and Immersive Environment Technologies: In FY06, developed tools required for trainers to address new types of asymmetric warfare scenarios. Used the student learner model to evaluate the effectiveness of the immersive training single-user module. Researched concepts to incorporate cultural simulation models to create appropriate asymmetric behaviors in immersive environments. In FY07, research and prototype an immersive asymmetric warfare training environment for Joint, Interagency Multi-National (JIM) distributed training, mission planning, and rehearsal. Conduct experiments to validate the metrics, tools, and methods of the single-user framework and extend it to accommodate a macro-level module for senior level command training. Identify methods to represent cultural behaviors/effects within an adaptive learning environment. Research using multi-sensory environments to capture and measure human performance to increase learning effectiveness. In FY08, will extend JIM environment capabilities for mission planning/rehearsal; integrate geo-specific environments and virtual human agents. Will enhance the tools and methods of single-user and macro-level training modules. Will integrate representative cultural behaviors/effects within adaptive learning environments. Will conduct experiments using multi-sensory environments, virtual humans, and effects for leader and critical thinking development. Will develop adaptive learning environments for non-kinetic warfare focused training using social simulations. In FY09, will conduct experiments utilizing JIM environment to evaluate training methods and mission planning/rehearsal tools. Will expand multi-sensory environment to enable virtual human and intelligent decision support entities to incorporate awareness of trainee actions. Will expand training development tools to rapidly portray additional representative cultures. Will expand non-kinetic simulation to squad/team level for training and battle command.	3052	3675	3959	4064
Small Business Innovative Research/Small Business Technology Transfer Programs		283		
Total	9336	10054	10850	11166

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**	**D02**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	5202	5948	5804	5965	6150	6278	6422	6568

A. Mission Description and Budget Item Justification: This project enables the transfer and maturation of simulation and training research results to the Army from program element (PE) 0601104, Project J08 (Institute for Creative Technologies). Goals of this research are to make training applications widely available and enhance the Army's ability to train any time and any place by researching modeling, simulation, and training technologies for individual and team training and leadership development; through the synthesis of creativity and technology by leveraging the capabilities of industry and the Research and Development (R&D) community; and by conducting research in virtual humans to enable them to embody natural language, speech recognition in noisy environments, gesture, gaze, and conversational speech. Achieving these goals requires research in techniques and methods for integrating different sensory cues into virtual environments that result in enhanced training and leader development; investigating the application of emerging photo-realistic rendering algorithms and 3-dimensional signal processing techniques to advanced experience learning applications; and enhancing the efficiency of 3-dimensional sound techniques in virtual environments that vary from medium sized immersive environment rooms with high-end graphics and computing systems to low-cost, game console applications using commercial off the shelf speakers. This project leverages and coordinates with work at the Army Research Institute and the Army Research Laboratory. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Research Development, and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Immersive Technology Environments: In FY06, investigated nonverbal communication techniques for virtual human interactions with Soldiers. Integrated the representations of selectable ethnicity and situational impact of emotions into the human to virtual human interaction. In FY07, conduct concept evaluations of leader training environments with enhanced virtual humans and integrate feedback into design for virtual human component technologies. In FY08, will investigate portrayal of dynamic effects in mixed reality environments and the use of new and emerging display technologies. Will investigate methods to capture trainee physical and emotional responses in the environment. In FY09, will create a mixed-reality immersive environment that uses sensors to provide near real-time perspective of the surrounding real world allowing a user and the world model to share a common view of the environment for high fidelity training environments. Will investigate new and flexible display technologies for development of new training environments.	2313	2628	2762	2853
Immersive Technology Techniques: In FY06, extended the tool sets and techniques for maturation of a single-user immersive learning environment. Conducted usability and effectiveness testing of single-user prototype components and tools. Developed new programming technology that allows a system's performance to be self-documenting by explaining its reasoning and how it works in easily understood English. Integrated captured photo-real images into a real-time simulation. Investigated a large-scale social simulation for visualizing and modeling densely populated urban environments and culturally-affected behaviors of the populace. In FY07, design techniques for creating a learning environment integrating a large-scale social simulation, advanced computer generated coaching and mentoring tools (artificial intelligence) into an immersive simulation environment. Investigate concepts and begin to design the tool sets that allow training developers to rapidly create or modify immersive learning scenarios. Advance explainable artificial intelligence technology in computer	2889	3153	3042	3112

coaches that detect learner impasses and provide advice and corrections to learners as they use training systems. Design tools for rapid simulation development. In FY08, will mature intelligent tutoring, computer coaching, and rapid simulation development tools. Will integrate virtual humans with large-scale social simulations. Will create simulation environment in which social and anthropological data and knowledge is used to affect virtual human behavior and hence shape the educational experience for a trainee to achieve the defined learning objectives established for a program of instruction. In FY09, will explore techniques for developing distributed asymmetric tutoring and coaching methods to support team training, performance assessment and, team after action reviews. Will expand single student tutoring capabilities to distributed multi-student and team assessments and reviews.				
Small Business Innovative Research/Small Business Technology Transfer Programs		167		
Total	5202	5948	5804	5965

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**	**D14**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
D14	Advanced Modeling and Simulation Initiatives (CA)	6710	5439						

A. Mission Description and Budget Item Justification: Not applicable for this item.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
New Accomplishment	6710	5439		
Total	6710	5439		

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	81693	91483	53342	49321	50536	52086	53253	54447
C05	ARMOR APPLIED RESEARCH	8439	9408	9434	9576	9999	10078	10300	10526
H77	ADV AUTOMOTIVE TECH	33817	14175	13997	14254	14411	14527	14868	15218
H91	TANK & AUTOMOTIVE TECH	30140	32595	29911	25491	26126	27481	28085	28703
T26	Ground Vehicle Technologies (CA)	9297	10285						
T31	NAT'L AUTO CENTER APP RES INIT (CA)		25020						

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This program Eement (PE) researches, investigates, and applies combat vehicle and automotive component technologies that enhance survivability, mobility, sustainability, and maintainability of Army ground combat and tactical vehicles. As combat vehicle systems become smaller and lighter, and tactical vehicles are more often exposed to combat conditions, one of the greatest technological and operational challenges is providing adequate crew protection without reliance on heavy passive armor. This challenge will be met using a layered approach, including long-range situational awareness, advanced lightweight opaque and transparent armors, Active Protection Systems (APS), and multi-spectral signature reduction. Project C05 focuses on designing, fabricating, and evaluating performance of integrated and appliqué lightweight armor packages (A-kits and B-kits) needed to provide lightweight combat vehicles protection against Chemical Energy (CE) and Kinetic Energy (KE) threats with less than one fourth the weight of conventional heavy armor. C05 also designs, fabricates, and evaluates structural and appliqué armors for tactical vehicles. Armor components that are matured and demonstrated for application to the Future Force and Tactical Wheeled Vehicle (TWV) and opportunities for current Force are described in PE 0603005A (Project 221). Project H77 funds the National Automotive Center (NAC). The goal of the NAC is to leverage large commercial investments in automotive technology, research, and development by pursuing automotive-oriented technology programs that have potential benefit to military ground vehicles. Project H91 researches and investigates a variety of enabling technologies in the areas of hybrid electric propulsion, mobility, thermal management, intelligent systems, vehicle diagnostics, fuels/lubricants, and water purification. Future Force vehicles and new tactical vehicles are being designed with hybrid electric architectures, advanced high power density engines, and auxiliary power units that provide power for propulsion, control systems, communications, life support systems, electromagnetic (EM) armor, Soldier battery charging, and export to other systems. Project H91 investigates and evaluates hybrid electric propulsion and electronic vehicle component technologies, which are key enablers for achieving Future Force and enhanced Current Force capabilities. In the near term, Project H91 designs and fabricates components and conducts experiments to determine/validate performance of these devices and various subsystems that will be used in Future Force vehicles and, where possible, as improvements in current combat and tactical vehicles. Modeling & Simulation (M&S) of Hybrid Electric Vehicle (HEV) performance of military missions (duty cycles) under realistic combat and tactical environmental conditions is conducted in support of the TWV Survivability effort. Project H91 also designs and evaluates components for improved vehicle performance and mobility including active suspensions, motors, regenerative brakes, vehicle electronics, generators, controllers, hybrid electric architectures, inverters, and lightweight metallic and segmented track. It investigates and fabricates components for high temperature/power electronics, high energy density energy storage devices, JP-8 reformation and desulphurization as a fuel source for fuel cells, and Pulse Forming Networks (PFNs) (batteries, switches, inductors, and capacitors) required for electric vehicle mobility and survivability. Over the far term, this effort will focus on components that increase vehicle energy and power levels to accommodate advanced electric weapons (such as lasers, high power microwaves, and electric guns) and advanced electric-based protection systems. Project H91 also investigates the use of augmented and virtual reality technologies for incorporating data available from local unmanned system assets to enhance the Soldier's local situational awareness and vehicle control in dynamic environments.

It researches the effects of vehicle motion on the Soldier during combat or tactical vehicle operations and how these effects can be minimized. Project T26 funds congressional special interest items. TWV work performed within this program element is a mutual effort between the Army and Marines for the next generation Light Tactical Vehicle. The PE is coordinated with the U.S. Marine Corps through the Naval Surface Warfare Center and with other ground vehicle developers within Defense Advanced Research Projects Agency (DARPA) and the Departments of Energy, Commerce, and Transportation. Products of this program primarily transition to PE 0603005A (Combat Vehicle and Automotive Advanced Technology) for maturation and incorporation into demonstration platforms/vehicles. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by Tank-Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, in collaboration with the Army Research Laboratory (ARL), Adelphi, MD.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	92857	59304	56743	50409
Current BES/President's Budget (FY 2008/2009)	81693	91483	53342	49321
Total Adjustments	-11164	32179	-3401	-1088
Congressional Program Reductions		-2849		
Congressional Rescissions				
Congressional Increases		35700		
Reprogrammings	-11164	-672		
SBIR/STTR Transfer				
Adjustments to Budget Years			-3401	-1088

FY06 funds decreased to support higher priority efforts.

Twenty-three FY07 congressional adds totaling $34218 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1054) Advanced Electric Drive
($1533) Liquid Desicant-Based Atmospheric Water Gen
($959) Nanofluids for Advanced Military Mobility Systems
($959) 50% Wgt Reduced, Multi-Hit Cap Transparent Armor
($2157) Adv Comp Materials Resch for Army Ground Vehicles
($959) Defect-Free Commercially Viable Si/C Semiconductor
($959) Lgt Weight Comp Brake for Armored Wheeled Vehicles
($1389) Multi-Sensor Payloads for Unmanned Systems
($958) Adv Mfg of Lightweight Materials & Components
($958) Component Optimization for Ground Systems (COGS)
($3690) Globally Accessible Manufacturing Activity (GAMMA)
($958) Ground Veh Reliability Prediction & Optimization
($2876) Hydrogen PEM Ambient Pressure Fuel Cell Med/Heavy
($958) HMMWV Hybrid Technology Conversion Kits (IIT)
($1870) Mat & User Eval of Hybrid Electric XM1124 HMMWVs
($958) Military Fuels Research Program
($958) Mobile Secure Wireless Sensor
($1390) Turbo Fuel Cell Engine
($1246) Transportable Synthetic Fuel Manufacturing Modules

($1294) Defense Transportation Energy Research
($3739) HAMMER
($1438) Plasma JP-8 Fuel Reformer
($958) Rapid Product Development and Deployment Portal

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**	**C05**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
C05 ARMOR APPLIED RESEARCH	8439	9408	9434	9576	9999	10078	10300	10526

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This project investigates, designs, and evaluates advanced armor materials, advanced structural armors, ballistic defeat mechanisms, and armor packaging concepts to achieve lightweight, ballistically-superior armors/structures that provide the last line of defense for the Future Force vehicles and Current Force combat and tactical vehicles. The effort also provides analysis, modeling, and characterization of advanced armor solutions designed to protect against existing and emerging threats, including collateral damage from residual debris generated by Active Protection (AP) threat defeat mechanisms. The Vehicle Armor Protection for Lightweight Combat Systems effort designs, fabricates, and evaluates performance of integrated and appliqué lightweight armor packages (A-kits and B-kits) or vehicle protection treatments that reduce weight, reduce space claims, and lower the cost for protection against medium Kinetic Energy (KE) projectiles, Chemical Energy (CE) warheads, Explosively Formed Penetrators (EFPs), and blast fragments from mines. These will be used in Future Force vehicles as well as spun out to Current Force vehicles. Goals are to provide base armor to defeat heavy machine guns and residual fragments from AP intercept events at 20 lbs/sq.ft. (or less); armor packages to defeat limited rocket propelled grenades (RPGs) and medium caliber KE at 40 lbs/sq.ft. (or less); and novel frontal armors to defeat heavier threats at 80 lb/sq.ft. for Future Force Vehicles (reducing this to 60 lb/sq.ft. for future insertion/upgrades). The Armor for Tactical Wheeled Vehicle (TWV) Survivability effort designs, fabricates, and evaluates structural and appliqué armors for tactical vehicles and investigates and characterizes effects of mine blasts on lightweight vehicles. Work conducted in this project provides armor components that are matured and demonstrated in the TWV Survivability effort described in PE 0603005A (Project 221), focusing on armor for protection from small arms and countermine applications, where possible, as add-on enhancements/upgrades. International cooperative research in mine blast characterization and vehicle response is also conducted. The armor technologies designed and fabricated in this project complement innovative non-armor survivability capabilities funded in Project H91. Efforts are fully coordinated with and complementary to work performed under program element (PE) 0602618A (Ballistic Technology) and PE 0602105A (Materials Technology). Products from this project generally transition to PE 0603005 for advanced demonstration. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, the Army's Tactical Vehicle Fleet Modernization Strategy, and the Defense Technology Area Plan (DTAP). Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, in collaboration with the Army Research Laboratory (ARL), Adelphi, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Vehicle Armor Protection for Lightweight Combat Systems: In FY06, fabricated advanced space frame structure and applied ceramic/metallic composite armor to the space frame design; demonstrated advanced appliqué armor; explored integration issues among ballistic, signature management; and related survivability technologies considering performance synergy durability, mounting approaches, manufacturability, and compatibility. In FY07, evaluate performance of future armor concepts for ballistic protection, demonstrate candidate armors against FCS objective threats to include small arms, medium caliber KE, and fragment defeat; apply and validate modeling and simulation tools; continue electromagnetic armor evaluations; and conduct experiments to determine the best solutions for integrating ballistic, signature management, and related survivability technologies. In FY08, will demonstrate optimized third generation armor (upgraded performance B armor package) and structure configurations; and conduct ballistic tests to verify final armor designs and integrate into second generation full sized concept vehicle structure (spaceframe demonstrator). In FY09, will mature revised future B armor options to meet changing threat and demonstrate structure configurations in the full-sized concept vehicle structure, Advanced	7937	8568	8792	8928

REconfigurable Spaceframe(ARES).				
Armor for Tactical Vehicle Survivability: In FY06, performed testing of multiple transparent armor solutions for application to all vehicles; developed and classified a comprehensive current and future threat list for use in evaluating various survivability components; fabricated an appliqué mine resistance armor kit solution and experimentally validated blast models and simulations. In FY07, evaluate advanced armor materials for tactical vehicles; evaluate performance of a lightweight blast/fragmentation appliqué under live-fire conditions. In FY08, will continue assessment of new armor solutions for implementation in the associated PE 0603005A TWV Survivability effort. In FY09, will conduct final armor assessments of potential candidates for spiral insertion.	502	613	642	648
Small Business Innovative Research/Small Business Technology Transfer Programs.		227		
Total	8439	9408	9434	9576

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**	**H77**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H77 ADV AUTOMOTIVE TECH	33817	14175	13997	14254	14411	14527	14868	15218

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This project funds the National Automotive Center (NAC), which leverages commercial investments in automotive technology research and development. NAC conducts shared technology programs, government, and industry, that focus on benefiting military ground vehicle systems. Component technologies being researched and investigated in this project support the combat and tactical vehicles in the Army's Current and Future Modular Force. Improvements in the Current Force are expected to rely heavily on leveraging commercial technologies for advances in operational capabilities and cost. The NAC serves as a catalyst, linking industry, academia, and government agencies for the maturation and exchange of automotive design and component technologies. The NAC core program is focused in two primary areas: Advanced Automotive Technology (AAT), and Future Tactical Truck System (FTTS) Advanced Concept Technology Demonstrator (ACTD). A major effort in AAT is Hybrid Electric Drive (HED) for tactical and light combat vehicles to improve fuel economy and mobility. Another major effort in AAT is fuel cell research, addressing fuel cell design and the equipment required to convert battlefield hydrocarbon fuels to hydrogen needed for fuel cell operation. AAT also includes efforts that address fuel efficiency, vehicle modernization, crew safety, maintenance, reliability, diagnostics and prognostics, network centricity, wireless communications, logistics improvement and manufacturing innovation with an overall goal of improving performance and endurance of ground vehicle fleets and reducing vehicle design, manufacturing, production, operating, and support costs. The FTTS ACTD implements and evaluates a number of advanced automotive technologies, which the Army and commercial sector have matured over the last decade, into tactical support vehicles for Future Combat System (FCS) and the Future Modular Force. The ACTD provides two variants of demonstrator vehicles for evaluation in a military unit field environment. ACTD test results will validate performance models, refine user requirements for tactical trucks, and reduce risk of insertion of certain advanced technologies into current and future tactical vehicle platforms such as the future Army/Marine light tactical vehicle. Some activities of the NAC are supported by other government agencies via Memoranda of Agreement (MOA) and Memoranda of Understanding (MOU). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Advanced Automotive Technology: In FY06,conducted joint military operation and evaluation of SmarTruck tactical vehicle capabilities for Homeland Defense/Security automotive needs; completed technology integration and evaluation of hybrid powertrain technologies; initiated mobile micro-grid technology development program; developed evaluation of new vehicle structures under varied loads; analysis of rollover characteristics; and analysis of dynamic stability of Tactical Wheeled Vehicles (TWV). In FY07, implement embedded diagnostics on current tactical vehicle platforms; integrate wireless sensor capabilities to provide oil analysis, tire pressure, and battery analysis; initiate integration of hybrid-hydraulic hybrid technology on TWV; develop inline oil sensing technology to provide condition data including viscosity, oxidation, lubricant contaminants; initiate vehicle integration efforts for fuel cell Auxiliary Power Unit (APU). In FY08, will: initiate development of thermoelectric power modules using wasted exhaust heat to power low current sensing devices on relevant TWV platforms; develop inline oil sensing technology to provide condition data including viscosity, oxidation, lubricant contaminants; expand hybrid-hydraulic hybrid technology effort to include demonstration on a light tactical vehicle platform; expand fuel cell Auxiliary Power Unit (APU) development to include on-vehicle demonstration. In FY09, will: evaluate thermoelectric power modules using wasted exhaust heat to power low current sensing devices on relevant TWV platforms; initiate technology evaluation of	12981	12962	13997	14254

fuel cell APU; complete qualification for alternative fuels program for ground vehicle systems; expand mobile micro-grid technology development program with large scale technology demonstration; continue crash modeling and safety design for TWV's.				
Future Tactical Truck System (FTTS) ACTD: In FY06, initiated and completed build of (1) Maneuver Sustainment Vehicle (MSV) demonstrator and (2) Utility Vehicles (UVs); completed safety certification testing for the MSV; initiated safety certification testing for the UV vehicles; began Military Utility assessment of the MSV. In FY07, finalize safety certification testing for the UV; complete the Military User Assessment (MUA) with both the MSV and UV vehicles; support the MSV and UV vehicles during a residual phase during which further user evaluation will be conducted. Results of the FTTS ACTD will feed requirements for development of the Army/Marine light tactical vehicles.	1000	1000		
Hydrogen PEM Fuel Cell Heavy Duty: This one-year congressional add developed a fuel cell bus with exportable power for use in the Army Mobile Microgrid Demonstration. No additional funds are required to complete this project.	1917			
Center for Tribology and Coating: This one-year congressional add continued research on lubricants to provide increased wear protection for vehicle systems and sub-systems in high-wear environments. No additional funds are required to complete this project.	1725			
Distributed Transportable Synthetic Fuel Manufacturing Modules: This one-year congressional add continued development of an air-transportable synthetic fuel production system. No additional funds are required to complete this project.	958			
Light Utility Vehicle (LUV): This one-year congressional add continued development of the LUV in support of FTTS efforts. No additional funds are required to complete this project.	3354			
Defense Transportation Energy Research: This one-year congressional add supported an Army-university-industry research coalition dedicated to research and technology development on fuels, fuel cells and auxiliary units. No additional funds are required to complete this project.	2012			
Gaming Technology Software Initiative (GTSI): This one-year congressional add integrated vehicle engineering simulation and advanced interactive visualization to create a multi-functional tool and integration point for next-generation vehicular technology. No additional funds are required to complete this project.	958			
HAMMER (Hydraulic Hybrid, Advanced Materials, & Multi-fuel Engine Research): This one-year congressional add developed infinitely variable transmissions and series hydraulic drive systems for enhanced mobility and fuel economy. No additional funds are required to complete this project.	1725			
Plasma JP-8 Fuel Reformer: This one-year congressional add developed a plasma reformer to meet the Army's needs for the on-board reformation of transportation fuels. No additional funds are required to complete this project.	1533			
Rapid Product Development and Deployment Portal: This one-year congressional add focused on the education and training needs of defense contracting entities and their supply chain, highlighting capabilities of current and emerging technologies for military use. No additional funds are required to complete this project.	1437			
Ultra Light Cargo Vehicle: This one-year congressional add integrated and demonstrated the Light Utility Mobility Enhancement System (LUMES) . No additional funds are required to complete this project.	3259			
Stoichiometric Explosive Detector System : This one-year congressional add continued integration of a stoichionatric explosive detector system onto an operational demonstrator platform. No additional funds are required to complete this project.	958			
Small Business Innovative Research/Small Business Technology Transfer Programs.		213		

Total	33817	14175	13997	14254

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602601A - Combat Vehicle and Automotive Technology**	**H91**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H91	TANK & AUTOMOTIVE TECH	30140	32595	29911	25491	26126	27481	28085	28703

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This project researches, investigates, and evaluates a variety of innovative and enabling technologies in the areas of vehicle concepts, virtual prototyping, power, thermal management, propulsion, mobility, survivability, vehicle diagnostics, fuels, lubricants, water purification, intelligent systems, and other component technologies for application to current and future combat and tactical vehicles. Future Force vehicles and new tactical vehicles are being designed with hybrid electric architectures, advanced high power density engines, and auxiliary power units that provide power for propulsion, control systems, communications, life support systems, electric-based weapons and protection systems, Soldier battery charging, and exportable power. The Hybrid Electric Vehicle (HEV) Components effort designs, fabricates, and evaluates critical components for energy storage (batteries), power distribution and power management, and conducts experiments to determine/validate performance of the components and various subsystems for use in FCS, future tactical vehicles, and, where possible, as improvements in current combat and tactical vehicles. Components developed under this effort are often incorporated into the Power & Energy Systems Integration Laboratory (P&E SIL), funded in PE 0603005A, Project 441, for evaluation and systems maturation. The HEV Experimentation and Assessment effort develops a technical approach to quantify battery state of charge within 5 percent error and the evaluation of the impacts of various power management strategies on fuel economy. The Pulse Power effort focuses, in the near to mid-term, on providing high energy/high power density components, and devices for Pulse Forming Networks (PFNs) and Pulse Power Supplies (PPS), which are enablers for several advanced electric-based weapon and protection systems, including Electromagnetic Armor (EMA). It designs and fabricates components for high temperature, high power electronics, high energy density energy storage devices, and PFNs. The JP-8 Reformation for Military Fuel Cells effort focuses on JP-8 reformation and desulphurization to provide hydrogen on which fuel cells can operate. The goal of the Propulsion/Prime Power effort is to design engines and generators and their components with significantly improved performance characteristics, efficiencies, and power densities. The Mobility effort for manned and unmanned vehicles focuses on improving drive component performance and reliability (e.g., running gear, tracks, and suspensions), fuels and lubricants, minefield clearance, counter obstacle bridging, and gap-crossing technologies to reduce logistics burdens associated with sustainment of manned and unmanned combat and tactical vehicles. The Vehicle Survivability effort provides advanced component technologies that contribute to a layered vehicle survivability approach to address emerging threats. This effort includes design and evaluation of active protection and hit-avoidance components, signature reduction materials, tracking/detection components for unmanned systems, laser protection materials, and advanced lightweight structures and opaque and transparent armors. This work complements, but does not duplicate, work performed under PE 0602601A, Project C05 (Armor Applied Research). The Water Generation, Recovery, and Purification effort focuses on reducing the logistics footprint by leveraging emerging technologies. The program designs enhanced water production technology, which can be embedded in combat and tactical platforms to support the individual Soldier and/or create distributed modular water production units. The Intelligent Systems Technology Research effort investigates improved operations of manned platforms through the application of sensing and autonomy technologies developed for unmanned systems. It performs applied research in control technologies incorporating drive-by-wire and autonomous mobility in combat and tactical vehicles; use of augmented and virtual reality to help the Soldier better control vehicles in highly dynamic environments; innovative approaches for extreme mobility of small to medium Unmanned Ground Vehicle (UGV) systems to include legged locomotion; minimizing vehicle motion effects for combat and tactical vehicle crews. Efforts in this project are closely coordinated the Army Research Laboratory (ARL), the Defense Advanced Research Projects Agency (DARPA), the U.S. Army Engineer Research, Development, and Engineering Center, Edgewood Chemical biological Center, and the Army Medical Department. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
HEV Components: In FY06, advanced high frequency silicon carbide (SiC) switch design and evaluated high voltage 150 kW DC-DC converter against FCS performance specifications; conducted a study on the efficiency improvements of motor drives through innovative pulse width modulation algorithm; increased Li-ion battery power and energy densities; continued to assess battery performance/potential and began integration of technologies into the P&E SIL; assessed impact of mine blast on Li-ion battery module. In FY07, validate significant performance and capability enhancements to SiC components (60 percent increase for inverters and a 250 percent increase for DC-DC converts in power density) and special high-power/high-energy Li-ion batteries (20 percent increase in power density), allowing for integration into a complete, compact hybrid power management system; design and fabricate SiC Metal Oxide Semiconductor Field Effect Transistor (MOSFET) motor drive and conduct experiments determining whether components, sub-systems, and systems can operate successfully at the required 110 degrees C without degradation in vehicle performance. This is a collaborative TARDEC and ARL effort. In FY08, will design and fabricate high power density DC-DC converter (8kW/l) using SiC MOSFET; demonstrate innovative thermal management technique achieving heat rejection rates of 300 W/cm2 and high inlet coolant temperatures (1100 C) compatible with SiC technologies; conduct computational fluid dynamics analysis on cooling systems to optimize their integration in vehicle platforms. In FY09, will evaluate and optimize viable sub-system cooling approaches such as spray cooling, sub-ambient cooling system, hybrid cooling loop technologies; identify and develop mitigation techniques for component and subsystem electromagnetic Interference (EMI) issues resulting from high switching speeds and high frequencies (50 kHz).	11196	9540	4684	4662
Hybrid Electric Vehicle Experimentation and Assessment: In FY07, quantify battery state of charge within and evaluate impacts of various power management strategies on fuel economy; exercise the test methodology to provide data for the TWV program. Develop and validate M&S tools to predict hybrid electric drive cycle performance with analysis of data on relevant performance characteristics to support all potential TWV HEVs and the TWV Fleet Modernization Strategy. M&S will also support test operating procedure development with simulation excursions and support duty cycle development. Additionally M&S will be used to analyze the Army/Marine Corps next generation tactical vehicle variants to determine the optimal set of advanced propulsion system architectures to meet variant OMS/MP requirements in support of the Amry/Marine Corps next generation tactical vehicle.		6000		
Pulse Power: In FY06, fabricated significantly enhanced performance of modular Si and SiC solid state switches by refining and evaluating device design and current sharing techniques; reduced the size of pulse charger inverter/rectifier circuits with transformer core improvements; enhanced energy density of fast-discharge, high-voltage capacitors with the use of diamond-like carbon (DLC), and film improvements via new chemistries and antioxidants; and designed and evaluated advanced ceramic high temperature thermal management techniques. In FY07, refine component designs, integrate, and test to validate performance enhancement and size reduction goals for SiC solid-state switches, pulse charger inverter/rectifier circuits, fast-discharge, high-voltage capacitors, and advanced thermal management technologies. In FY08, will increase pulse width of Si and SiC switches by 10X, increase power density of converters by 3X, and increase power density for batteries and capacitors by 2X to provide compact power conditioning and energy/power storage for applications such as EM gun, laser, and other directed energy weapons. In FY09, will demonstrate first generation pulse switches, power converters, and power, and energy storage.	5613	5206	2177	3317
JP-8 Reformation for Military Fuel Cells: In FY06, initiated development of key components of the reformation system (JP-8 desulfurizer, reformer, thermal management, and control) that meet reformate hydrogen gas purity requirement for both proton exchange membrane (PEM) fuel cells and solid oxide fuel cell (SOFC) for power generation applications. In FY07, start initial integration of system components into a functional brass board and test the "best in class" optimized JP-8 reformer equipped with desulfurization, thermal management, and system control logic. In FY08, will conduct comparison evaluations of fuel cell power modules, PEM's, High	3000	1627	5806	3900

Temperature PEMs (HTPEM), and SOFCs to identify technology gaps in thermal management, load following capabilities, power management, system integration, and overall system requirements. In FY09, will test brass board system for 1000 hrs of continuous operation to establish the key requirements to meet form, fit, and functionality of the complete reformer/fuel cell power module; identify preferred manufacturing techniques, and develop cost estimates for commercial production and vehicle life cycle costs based on reduced fuel consumption and reduced engine speeds resulting from using fuel cells.				
Propulsion/Prime Power: In FY06, completed the Opposed Piston Opposed Cylinder (OPOC) analysis and design, and completed high speed combustion analysis. In FY07, initiate surrogate engine fabrication for the OPOC engine. In FY08, will complete fabrication of the OPOC engine and perform optimization, performance testing and 50 hour NATO durability test demonstration. Initiate concept analyses and designs for low heat rejection, oil cooled, high speed, and high power density engine design. Initiate concept analyses and design of a closed loop controlled fuel injection system for heavy fuel operation to achieve constant power. In FY09, will fabricate high speed engine test rig to demonstrate 6000-7000 RPM diesel operation (60 percent over current engines); fabricate and evaluate full authority fuel injection system on test high power density engine.	1931	2381	7594	4103
Mobility: In FY06, conducted evaluations at the Maneuver Support Center (MANSCEN) of gap defeat breadboard prototypes; completed unmanned ground vehicle tactical behavior architecture designs; evolved mobility models, terrain models, and motion effects mitigation techniques; performed experiments validating motion mitigation techniques concepts, modeled complex obstacles, and executed power duty cycle experiment; identified technical and economic barriers to using a single lubricant based on input from key original equipment manufactures, oil, and additive formulators, and military integrators; and tested current Army arctic engine oil (candidate single lubricant) under high temperature conditions and identified key areas for improvement. In FY07, working with industry, further investigate the technical and economic barriers to single lubricant development; identify key test and evaluation requirements to understand and verify technical barriers; collect relevant economic information; and conduct initial cost analysis. In FY08, will complete technical investigations and conduct final cost analysis; complete technical and economic feasibility report.	5563	1366	1374	
Vehicle Survivability (Active Protection/Ballistic Protection /Laser Protection /Minefield Clearance): In FY06, completed, design and fabricated prototype countermine (CM) mission modules prototypes; revised blast modeling and simulation database; added Global Positioning System to the sensor fusion situational awareness system; added templates for threat detection to alert users to threats; evaluated low cost signature management techniques; and conducted initial concept studies for next generation tactical platform protection technologies. In FY07, mature CM mission modules prototypes and develop interface/platform baseline requirements and conduct advanced trials; perform simulation and modeling of advanced survivability technologies for tactical vehicles. In FY08, will purchase long lead materials and begin fabrication of advanced survivability technologies, to include active, ballistic, and laser protection, to address emerging threats. In FY09, will continue fabrication and begin component testing and evaluation, assessing advances against current and potential future asymmetric threats.	1794	4130	3142	3194
Water generation, recovery, and purification: In FY06, completed water-from-exhaust HMMWV evaluations under test track conditions; designed, fabricated, and demonstrated a water-from-air device mounted on a Heavy Expanded Mobility Tactical Truck to evaluate performance on a moving vehicle and identify the environmental operational envelope. In FY07, conduct field experimentation and modeling and system analysis of water from air device. In FY08, will develop and test alternative disinfection technology and analyze rate and transformation of water contaminants in order to reduce health risks and improve water quality. In FY09, will determine likely contaminates of concern and their concentrations; evaluate the performance and health and safety impacts of new water purification membranes.	1043	1730	2070	2205
Intelligent Systems Technology Research: In FY07, conduct M&S to investigate improvements to the mobility and local situational		256	3064	4110

awareness tasks of manned ground vehicles from the application of sensing and autonomy developed for unmanned ground vehicles; begin an analysis based on user requirements for a small robot incorporating legged locomotion to support dismounted operations in complex terrain. In FY08, will determine design approaches for displays involving a mix of live video and computer generated graphics, and solutions for the transfer of mobility control between manned driving and autonomous driving modes for manned vehicles, complete the analysis of a small-legged robotic system, and conduct modeling and simulation to explore design approaches; develop embedded real-time dynamic mobility models to predict manned and unmanned vehicle responses and prevent unsafe mobility situations while under robotic control. In FY09, will explore effects of vehicle motion on crews utilizing autonomous navigation capabilities and enhanced local situational awareness and refine concepts and transition results and recommendations for augmented reality and embedded dynamic mobility models.				
Small Business Innovative Research/Small Business Technology Transfer Programs.		359		
Total	30140	32595	29911	25491

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602618A - BALLISTICS TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	50152	58568	55014	55736	55672	55850	56939	58130
H03	ROBOTICS TECHNOLOGY	13130	16237	16177	16498	16083	15964	16315	16674
H75	ELECTRIC GUN TECHNOLOGY	4382	5179	3968	4065	4098	4120	4222	4326
H80	BALLISTICS TECHNOLOGY	29191	30229	34869	35173	35491	35766	36402	37130
HB1	SURVIVABILITY AND LETHALITY TECHNOLOGIES (CA)	3449	6923						

A. Mission Description and Budget Item Justification: This program element (PE) provides ballistic technologies required for armaments and armor to support the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. This technology will permit US dominance in future conflicts across a full spectrum of threats in a global context. Project H03 focuses on applied research for advanced autonomous mobility technology for future land combat systems. Project H75 focuses on technologies for electric armaments which offer the potential to achieve leap-ahead lethality capability by providing hypervelocity and hyperenergy launch well above the ability of the conventional cannon. It also includes work in hypervelocity penetrator effectiveness that will greatly increase anti-armor capabilities. Project H80 is focused on lethality and survivability technologies, including research on lightweight armors and structures; kinetic energy active protection; crew and component protection from ballistic shock and mine-blast; insensitive propellants/munitions; novel multi-function warhead concepts; affordable precision munition technologies; physics-based techniques, methodologies, and models to analyze combat effectiveness of future technologies. Projects H03 and H80 will enable lethality and survivability technologies for the Future Force. Work in this PE is related to and fully coordinated with efforts in PE 0602105A (Materials Technology), PE 0602120A (Sensors and Electronic Survivability), PE 0602601A (Combat Vehicle and Automotive Technology), PE 0602624A (Weapons and Munitions Technology), PE 0602705A (Electronics and Electronic Devices), PE 0602716A (Human Factors Engineering), PE 0602782A (Command, Control, Communications Technology), PE 0603004A (Weapons and Munitions Advanced Technology), and PE 0603005A (Combat Vehicle Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602618A - BALLISTICS TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	52010	52221	51092	52188
Current BES/President's Budget (FY 2008/2009)	50152	58568	55014	55736
Total Adjustments	-1858	6347	3922	3548
Congressional Program Reductions		-224		
Congressional Rescissions				
Congressional Increases		7000		
Reprogrammings	-1858	-429		
SBIR/STTR Transfer				
Adjustments to Budget Years			3922	3548

Four FY07 congressional adds totaling $6709 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1390) Adv Tungsten Penetrators and Ballistic Materials
($3115) Laser Bsd Explosive- Chem/Bio Standoff & Point Det
($958) Stand Off Explosives Detector
($1246) TAC-C Robotic Vehicles for SOF

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602618A - BALLISTICS TECHNOLOGY**	**H03**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H03 ROBOTICS TECHNOLOGY	13130	16237	16177	16498	16083	15964	16315	16674

A. Mission Description and Budget Item Justification: Research in this project advances autonomous mobility technology for the Future Force. It will investigate robotics technology critical to the maturation of future Army systems, including unmanned elements of the Future Force, Future Force Warrior (FFW), and crew aids for future manned systems. It provides the basis for the Collaborative Technology Alliance (CTA) in robotics, which is a tri-service research consortium joining researchers from the Department of Defense (DOD), other Government agencies, industry, and academia in a concerted, collaborative effort to advance key enabling technologies. Achieving these goals will provide future land combat forces with significant new operational capabilities permitting paradigm shifts in the conduct of ground warfare, providing significantly greater survivability and deployability. Technical efforts are focused on advancing perception for autonomous ground mobility, intelligent vehicle control and behaviors, and human supervision of unmanned ground systems. Research products will enable both semi-autonomous and near autonomous unmanned ground vehicles (UGVs) with products transitioning to advanced development efforts. Research is conducted at the Army Research Laboratory, other DOD laboratories and research centers, National Institute of Standards and Technology, National Aeronautics and Space Administration, and Department of Energy research laboratories, as well as industry and academic institutions. The applied research conducted in this program will be transitioned to technology development, demonstration, and materiel acquisition programs being conducted by the Office of the Secretary of Defense Joint Robotics Program and each of the Services. Research supports collaborative efforts with Defense Advanced Research Projects Agency (DARPA). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Execute CTA for advanced perception, control/behavior, and man-machine interface technology required for high-speed mobility (including robotic-follower operations) and basic tactical behaviors common to multiple military missions. Research focuses on new sensor and sensor processing algorithms for rapid detection and classification of objects in the environment enabling safe high-speed mobility and intelligent tactical behavior by future unmanned systems; implementing adaptive control strategies that will enable unmanned systems to display intelligent tactical behavior, and development of human-robot interaction (HRI) scalable, intuitive, multi-modal control interfaces that will minimize the additional cognitive workload for Soldiers controlling unmanned assets. In FY06, conducted research enabling safe operation of semi-autonomous vehicles in populated environments, including movement in dynamic environments, a key barrier to the utilization of unmanned systems in future urban military operations, providing the ability to detect and classify moving vehicles and pedestrians from a moving platform. In FY07, focus on multi-sensor fusion approaches towards improved perception in dynamic and urban environments and permit meaningful collaboration by autonomous vehicles (including mixed air and ground assets) utilizing the scout reconnaissance mission as the focus for technology development. In FY08, will focus upon improved object recognition and feature detection to enable tactical behavior and initiate creation and integration of mechanisms to adapt to intelligent adversaries. In FY09, will mature technology for scene understanding and autonomous tactical behavior in the context of reconnaissance mission scenarios.	6115	7109	7334	7508
Mature perception and intelligent control technologies required to meet objective capabilities for the armed robotic vehicles and transition this technology to advanced development programs being conducted under PE 0603005A (Combat Vehicle Advanced Technology)	4599	4805	4865	4958

project D515 for integration into test bed systems. Leverage DARPA sponsored research, e.g., Software for Distributed Robotics, for control of collaborating agents to enable mixed teams (manned/unmanned) to conduct military missions. In FY06 conducted research in perception and control technologies for autonomous mobility that will permit realistic operational speed for UGVs that could spiral to Current Force. In FY07, conduct research in perception and control technologies that will permit unmanned ground vehicles to safely maneuver in dynamic environments at increasing speeds. In FY08 will mature perception and control technology to permit implementation of behaviors to enhance the operational effectiveness of robotic vehicles. In FY09, will mature robotics technology that will permit unmanned vehicles to adapt to dynamic situations found in tactical environments.				
Integrate technology on unmanned ground vehicle test beds and conduct extensive field exercises for experimentation, technology characterization, and to show capability maturation for near autonomous UGVs. Leverage algorithms being conducted under DARPA sponsored research, e.g., Learning Applied to Ground Robotics (LAGR). Conduct regular, periodic experimentation at Ft. Indiantown Gap, PA, and other military facilities to stress technology in complex environments to further focus CTA sponsored research, assess performance, and provide the opportunity for US Army Training and Doctrine Command to initiate early development of the Tactics, Techniques, and Procedures required for successful utilization of unmanned systems in future conflicts. In FY06, incorporated advanced perception and control technology and transitioned to Future Combat Systems Autonomous Navigation System prototypes for evaluation in relevant environments. In FY07, evaluate technologies for safe operation of unmanned vehicles in dynamic on- and off-road environments. In FY08, will evaluate technologies to enable collaborative operation of near-autonomous unmanned systems, including networked air and ground unmanned vehicles, managed by a single Soldier. In FY09, will evaluate the ability of unmanned ground vehicles to autonomously adapt to dynamic tactical environments.	2416	3897	3978	4032
Small Business Innovative Research/Small Business Technology Transfer Programs		426		
Total	13130	16237	16177	16498

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602618A - BALLISTICS TECHNOLOGY**	**H75**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H75 ELECTRIC GUN TECHNOLOGY	4382	5179	3968	4065	4098	4120	4222	4326

A. Mission Description and Budget Item Justification: This project funds applied research for the Army Electromagnetic (EM) Gun Program. Future combat vehicles will require more lethal yet compact main armament systems with significant enhancements in survivability, reductions in logistics footprint, and decreases in system signature. This project evaluates the potential of EM guns to provide such leap-ahead armaments capabilities that are fully integrated with electric propulsion and electromagnetic armor systems to provide the efficient, highly mobile, and deployable armored force. Focus is placed on addressing EM system technical barriers, in particular advanced materials for pulsed power; robust, compact, and lightweight launchers; full-scale, hypervelocity utility of novel kinetic energy penetrators (NKEPs) against a range of present and future threats; and efficient high energy launch packages. In the area of pulsed power, evolve the high strength composite materials critical for compact pulsed alternators. For the launcher, establish and mature technologies needed to incorporate high strength, low density materials which provide long life, fieldworthy EM cannon. In the area of launch projectiles, develop lethal mechanisms that take advantage of the hypervelocity capability of EM guns and provide the armature and sabot technologies needed for accurate, low parasitic mass launch packages. The research is conducted at the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD, with extensive university and industry support. The resulting developments are moved directly into the Armament Research, Development, and Engineering Center (ARDEC) where they are being incorporated by industry into an EM gun system. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by ARL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Pulsed Power: In FY06, proved advanced low-density, high-strength composites for field coil support and efficient switch packaging. In FY07, establish optimal active cooling of high speed pulsed alternator rotors and develop high conductivity materials. In FY08, will prove high-strength, low-density, high-conductivity conductor technology and investigate high current switch materials. In FY09, will show capabilities of advanced materials (bandings, conductors, and switches) to reduce pulsed alternator size and mass.	607	1079	1500	1615
Launcher: In FY06, validated robustness of composite launcher and established Cold Spray rail coating technique. In FY07, experimentally validate performance of three meter long 500 kJ composite electromagnetic launcher with long bore life and transition technology to ARDEC.	1100	1200		
Projectile: In FY06, electromagnetically launched a two MJ monolithic rod and established accuracy of prototype projectile. In FY07, launch fully-functional NKEP at two MJ. In FY08, will establish technologies to eliminate arcing at the projectile/launcher interface. In FY09, will demonstrate large-caliber (>5 MJ) kinetic energy and multipurpose projectiles launched from an EM gun.	1275	1300	1300	1300
Full-Scale Hypervelocity Lethality: In FY06, investigated reactive materials (RM) for light target defeat and matured mechanisms to deploy NKEP in flight. In FY07, compare RM and high explosive fills at hypervelocity and validate performance of deploying NKEP against realistic targets. In FY08, will experimentally validate prototype RM multipurpose round at 2 MJ muzzle energy. In FY09, will demonstrate full scale (>5MJ muzzle energy) RM warhead and transition to ARDEC.	1200	1200	800	800
Analysis: In FY06, analyzed performance of hypervelocity projectiles against aerial targets. In FY07, devise techniques to incorporate EM gun-equipped hybrid vehicles into force-on-force models. In FY08, will analyze utility of EM guns on the battlefield. In FY09, will	200	287	368	350

define the guidance and control parameters needed to increase hypervelocity hit probability.				
Small Business Innovative Research/Small Business Technology Transfer Programs		113		
Total	4382	5179	3968	4065

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602618A - BALLISTICS TECHNOLOGY**	**H80**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H80 BALLISTICS TECHNOLOGY	29191	30229	34869	35173	35491	35766	36402	37130

A. Mission Description and Budget Item Justification: The goal of this project is to provide key technologies required for armor and armaments that will enable US dominance in future conflicts across a full spectrum of threats. The program supports the Army vision by focusing on more lethal and more deployable weapons and on survivability technologies to lighten and the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The challenge is to ensure combat overmatch and survivability while achieving rapid deployability in a lighter weight platform (less than 20 tons). Specific technology thrusts include: lightweight armors and structures to defeat existing and emerging ballistic threats; universal Active Protection (AP) to defeat/degrade threats before they reach the combat platform; crew and component protection from ballistic shock, mine-blast, and fuel or ammunition fires; insensitive high energy propellants/munitions to increase lethality of compact weapon systems and to reduce propellant/munition vulnerability to attack; novel kinetic energy (KE) penetrator concepts to maintain/improve lethality while reducing the size/mass of the penetrator; novel multi-function warhead concepts to enable defeat of full-spectrum of targets (anti-armor, bunker, helicopter, troops); affordable precision munitions technologies for launch, flight, and precision strike; physics-based techniques, methodologies, and models to analyze combat effectiveness of future technologies for improved ballistic lethality and survivability. The work is conducted at the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD, and provides required technologies for advanced development programs at the Armaments Research, Development, and Engineering Center (ARDEC), Picatinny Arsenal, NJ; the Tank and Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI; and the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), Huntsville, AL. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by ARL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Optimize advanced lightweight structural, ceramic, and electromagnetic armor technologies for transition to Future Force (FF) vehicle designers, current, and Future Force platforms and tactical vehicles. In FY06, validated the advanced technology for shaped charge defeat and applied design tools to tactical vehicles to increase their survivability against small arms and improvised explosive devices. In FY07, experimentally validate integrated and add-on ballistic protection technologies that make tactical combat vehicles more survivable; design and validate armor configurations for Future Force Objective threats. In FY08, will mature hybrid armor designs with lower densities that defeat tactical vehicle threats; experimentally validate optimized third generation armor and structure configurations for Future Force threats; explore novel electromagnetic armor mechanisms for full spectrum defeat. In FY09, will prove hybrid armor designs that defeat future tactical vehicle threats with further density reductions; experimentally show objective threat defeat at goal vehicle weights; prove explosive threat defeat at lightest weights possible; evaluate novel electromagnetic armor mechanisms to predict performance.	4872	6286	9861	11860
Mature mine blast, ballistic shock mitigation, and crew protection technologies to enable survivability of current and Future Force platforms, ground tactical vehicles, and the individual Soldier. In FY06, advanced models and matured first-generation designs for advanced technology (AT) mine blast protection structure/crew system. In FY07, provide design guidance and proven AT mine blast protection structure/crew system to vehicle designers for ground tactical vehicles; validate technologies to improve flexibility of protection equipment (torso, extremities, neck) for individual Soldier. In FY08, will design lightweight, easily installed blast-penetrator protection (to include better seat designs) for occupants of tactical wheeled vehicles; experimentally prove response of an ammo event minimizing	2650	3364	3500	3550

lethal effects within crew compartment. In FY09, will devise models for Advanced-Electromagnetic Armor (A-EMA) mine protection and support experimental validation of A-EMA mine armor kits; prove full-scale explosive loading with test apparatus to simulate vehicle borne or roadside blast fragment loading; transition second generation flexible protection equipment for individual Soldier to development community.				
Mature advanced technologies to enable a broad spectrum of affordable precision munitions. Mature a multi-disciplinary approach to munition system design by coupling physics-based models of interior ballistics, launch dynamics, flight mechanics, and high-G guidance, navigation, and control (GN&C) technologies to enable smaller, cheaper, and lighter low-collateral-damage precision munitions for future asymmetric operations in Military Operations on Urban Terrain (MOUT). In FY06, addressed the developing technologies that enable guided medium-caliber munitions for the Extended Area Protection System (EAPS) as well as for infantry operations in MOUT. In FY07, model and validate EAPS subcomponent technologies by performing integrated critical flight demonstrations of candidate subsystems; mature subcomponent technologies to enable smaller, lighter, cheaper munitions components. In FY08, will perform an integrated flight demonstration of a supersonic medium-caliber interceptor; experimentally validate smaller, lighter, cheaper munitions components and transition to development community. In FY09, will address technology that enables precision fires for small unit MOUT operations.	4075	4100	4350	4400
Mature propulsion and energetics technologies. Evaluate, select, and validate novel/nanostructural insensitive energetic materials concepts that exploit managed energy release and are required for improving the effectiveness and reducing the vulnerability of Future Force gun/missile systems and warheads. In FY06, down-selected a weapons system application for validation of novel insensitive energetic material (gun/rocket/propellant/multi-purpose warhead) and matured numerical tools for insensitive munitions design. In FY07, validate selected system using advanced energetic material with tuned energy release (gun/rocket propulsion/multi-purpose warhead) with increased performance while meeting insensitive munition requirements and apply emerging numerical tools to novel insensitive munitions. In FY08, will utilize reactive materials, novel energetics, and nano-structured materials to enhance propellant, igniter, explosive performance, reduce sensitivity, and provide increased multipurpose applications; formulate, evaluate, and characterize propulsion and detonation performance of common low-cost novel insensitive formulations; employ experiments, modeling, and simulation to reduce munition vulnerability and enhance performance and effectiveness. In FY09, will apply ballistic modeling and simulation to evaluate low-vulnerability propulsion charge configurations at reduced caliber for MOUT and gun launched rockets; apply reactive materials and nano-structured materials to enhance energy output with less propellant and explosive material; derive and apply chemical and physical mechanisms to reduced erosion via dynamic nitriding; determine the effects of physical modification and compartment packing design of munitions on the vulnerability of propellants and explosives to fast and slow cook-off, bullet and fragment impact, shaped charge jet impact; evaluate performance of advanced enhanced blast explosive formulations and munitions.	5250	5106	4650	4650
Mature active protection counter-munition and sensor technologies to effectively defeat all anti-armor munitions including kinetic energy (KE) projectiles, which is critical to enable survivability of Future Force platforms. In FY06, optimized universal counter-munition performance through improved modeling, materials, and experimentation. In FY07, transition optimized universal counter-munition to TARDEC, ARDEC and AMRDEC; provide database of blast warhead technology versus shaped charge threats. In FY08, will mature enhanced explosive warhead technology and experimentally validate versus KE and shaped charge threats.	2300	1100	1600	
Mature advanced ammunition and lethality technologies. Identify and model preferred options to reduce energy/mass required to defeat emerging armor threats and to provide multi-purpose capabilities for revolutionary Future Force lethality. In addition, investigate technology options for scaling warhead lethality to enhance MOUT war fighting including control of collateral damage. In FY06, conducted terminal ballistic assessment of Multi-Threat Objective Projectile (M-TOP) technology vs. targets of interest; integrated lethal mechanisms and proved broad, multi-functional target defeat capabilities; modeled terminal effects of counter-rockets, artillery and mortar (RAM) engagements. In FY07, conduct full-scale experimental validation of terminal ballistic performance; investigate weapons effects	4410	4450	4175	3775

in MOUT environment; experimentally evaluate scalable warhead component technologies and down select best technology candidates. In FY08, will perform end-to-end validation of M-TOP warhead; transition M-TOP technologies (including analytic and numerical models for weapons effects) to ARDEC and AMRDEC; mature scalable warhead component technologies and prepare for possible technology transitions. In FY09, will prove integrated scalable warhead technology for blast, fragmentation and penetration effects in urban environments.				
Devise state-of-the-art survivability/lethality/vulnerability (SLV) methodologies to dynamically model the interaction of conventional ballistic threats versus Future Force systems. In FY06, validated capability to analyze shock effects using production SLV code Modular Unix-based Vulnerability Estimation Suite (MUVES); incorporated high fidelity personnel modeling capability, Operational Requirement-based Casualty Assessment (ORCA) into MUVES; improved modeling of Active Protection System (APS) interactions; improved damaged helicopter effects models; transitioned geometry engine Ballistic research Laboratory - Computer Aided Design (BRL-CAD) to open source; and devised initial penetration algorithms for MOUT debris fragments against personnel. In FY07, complete validation of ORCA for blast and bullets; incorporate improved modeling of bullets, structure debris, and personnel injury metrics into ORCA; prove capability to assess blast loading and target effects using MUVES; devise methods to asses multi-hit effects on ceramic armor performance; prove automated analysis capability of APS engagement and residual effects on target; enhance SLV analysis visualization capability. In FY08, will mature methodologies to analyze emerging technologies and survivability in a networked, system of systems context and will validate for production use. In FY09 will deliver production version of new SLV modeling framework; will devise modeling capability to analyze newly emerging threats and systems.	5634	5680	6733	6938
Small Business Innovative Research/Small Business Technology Transfer Programs		143		
Total	29191	30229	34869	35173

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602622A - Chemical, Smoke and Equipment Defeating Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	9856	12762	2235	2301	2328	2365	2417	2470
552	SMOKE/NOVEL EFFECT MUN	1997	2032	2235	2301	2328	2365	2417	2470
BA1	Protection Technologies (CA)	7859	10730						

A. Mission Description and Budget Item Justification: The goal of this program element (PE) is to research and investigate smoke and obscurant technologies to increase personnel and platform survivability. This PE funds applied research in materials science and dissemination methodologies and mechanisms to counter enemy weapon target acquisition systems and/or degrade enemy surveillance capability. The obscurant materials and dissemination systems will be designed to be effective, safe, and environmentally acceptable. Modeling and Simulation (M&S) tools will be developed and used to analyze the ability of newly developed obscurant materials to increase survivability of Soldiers and platforms. Work in this PE is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This PE contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0603004, project L97. This work is performed by the Army Research, Development, and Engineering Command, Edgewood Chemical Biological Center, Edgewood, MD.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602622A - Chemical, Smoke and Equipment Defeating Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	10567	2212	2252	2305
Current BES/President's Budget (FY 2008/2009)	9856	12762	2235	2301
Total Adjustments	-711	10550	-17	-4
Congressional Program Reductions		-206		
Congressional Rescissions				
Congressional Increases		10850		
Reprogrammings	-711	-94		
SBIR/STTR Transfer				
Adjustments to Budget Years			-17	-4

Seven FY07 congressional adds totaling $10399 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1055) Systems for Sampling & Detecting Bioaerosols
($958) Appl of CHP-105 to Class A Biowarfare Agents
($2588) Bfld Prod of Modified Vaporous Hydrogen Peroxide
($2300) Biomarker Molecular Toxicology Initiative
($958) Nanocrystalline Solid Decontamination Technology
($1246) Rapid & Accurate Pathogen ID/Detection (RAPID) Pro
($1294) Thermal Ac Decon w/Mod Vaporous Hyd Peroxide

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602622A - Chemical, Smoke and Equipment Defeating Technology**	**552**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
552 SMOKE/NOVEL EFFECT MUN	1997	2032	2235	2301	2328	2365	2417	2470

A. Mission Description and Budget Item Justification: Project 552 researches and investigates smoke and obscurant technologies with potential to enhance personnel/platform survivability by degrading threat force surveillance sensors and defeating the enemy's target acquisition devices, missile guidance, and directed energy weapons. It investigates advanced infra-red (IR) and multi-spectral obscurant materials with potential to provide effective, affordable, and efficient screening of deployed forces, while being safe and environmentally acceptable. Other efforts within this project advance dissemination, delivery, Modeling and Simulation (M&S), and vehicle protection technology through the use of obscurants and how it spreads to expand survivability options through increased standoff and threat protection. A major effort on dissemination of advanced infrared (IR) obscurants is making improvements to a high performance IR obscurant so the material can be effectively used in smoke pots and grenades. M&S tools will be investigated to predict performance and analyze strategic use of obscurants on the battlefield. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Edgewood Chemical Biological Center, Edgewood, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Advanced Obscurants: In FY06, determined viable methods for smoke dissemination and modified promising high performing materials to maximize dissemination behavior. In FY07, refine the loading techniques of IR materials into munitions and evaluate these techniques for their effect on smoke dissemination; evaluate performance of these materials in a laboratory environment. In FY08, will perform Modeling and Simulation to determine the survivability increase achieved over current smoke systems; will conduct a technology evaluation of selected prototype grenade. In FY09, will conduct review of existing theory, examine alternate theoretical approaches, determine particle characteristics based upon theory, and solicit industry for technological solutions for new high performing, low toxicity visual obscurants. Will conduct studies of spectrally-selective obscurant concepts.	1036	1120	1335	1400
Obscurant Enabling Technology for other smoke capabilities (non IR obscurants): In FY06, performed a field demonstration whereby obscurants were deployed at a longer range and at a faster response time which led to improved vehicle and dismounted Soldier protection. In FY07, investigate novel non-thermal dissemination methods for visual smoke assess the impact of contrast reduction on the effectiveness of obscurant materials using modeling and simulation. In FY08, will conduct studies to examine performance improvements in low toxicity visual obscurant and new Millimeter Wave obscurants. In FY09, will conduct studies of dissemination techniques for low toxicity visual obscurants and new Millimeter Wave obscurants.	961	888	900	901
Small Business Innovative Research/Small Business Technology Transfer Programs		24		
Total	1997	2032	2235	2301

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602623A - JOINT SERVICE SMALL ARMS PROGRAM**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	6449	6178	7008	7571	7790	8039	8433	8830
H21	JT SVC SA PROG (JSSAP)	5490	6178	7008	7571	7790	8039	8433	8830
S50	SMALL ARMS APPLIED RESEARCH (CA)	959							

A. Mission Description and Budget Item Justification: This program element (PE) researches and designs individual and crew-served weapon technology that enhance the fighting capabilities and survivability of dismounted battlefield personnel in support of all Services. The technology enhancement efforts of this PE assure that the next generation of small arms weapons systems will overmatch the evolving threat and address the needs of the Future Force, and, where practical enhance the Current Force. Project H21 designs and evaluates component technologies for the Lightweight Small Arms Technologies (LSAT) effort. LSAT provides technologies that will significantly reduce weight compared to currently fielded weapons and associated ammunition. LSAT will lighten the Soldier's load, provide improved battlefield mobility, and reduced logistics burden to maximize operational utility and survivability, while maintaining or improving current levels of performance. Work here also advances small arms capability through the design and evaluation of improved small arms lethality, utility, and technical fire control via new projectile designs, warheads and target locating, and aiming devices. Project S50 funds congressional special interest items. All Joint Service Small Arms Program (JSSAP) efforts are based upon the Joint Service Small Arms Master Plan (JSSAMP), the Joint Capabilities Integration Development System's Small Arms Analyses, and the resulting Capabilities Development Documents of the Services. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), and the Defense Technology Area Plan (DTAP). This program is managed by the US Army Armament Research, Development, and Engineering Center (ARDEC), Picatinny, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology), and PE 0603607A (Joint Service Small Arms Program), but the work conducted under this PE is not duplicated under any other PE. Transition paths have been established in coordination with Program Executive Officer (PEO) Soldier, Project Manager Soldier Weapons, Product Manager (PM) Crew Served Weapons, PM Individual Weapons, USMC PM Infantry Weapons, and PEO Special Programs, U.S. Special Operations Command (SOCOM). Project S50 contains congressional adds only.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602623A - JOINT SERVICE SMALL ARMS PROGRAM**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	6607	6247	6362	6435
Current BES/President's Budget (FY 2008/2009)	6449	6178	7008	7571
Total Adjustments	-158	-69	646	1136
Congressional program reductions		-24		
Congressional rescissions				
Congressional increases				
Reprogrammings	-158	-45		
SBIR/STTR Transfer				
Adjustments to Budget Years			646	1136

FY08 and FY09 funds increased to support development of smaller, lighter weight, small arms (weapons and rounds) with increased target acquisition/tracking capability.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602623A - JOINT SERVICE SMALL ARMS PROGRAM**	**H21**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H21	JT SVC SA PROG (JSSAP)	5490	6178	7008	7571	7790	8039	8433	8830

A. Mission Description and Budget Item Justification: This project researches and designs individual and crew-served weapon technologies that enhance the fighting capabilities and survivability of dismounted battlefield personnel in support of all the Services. The technology enhancement efforts of this PE assure that the next generation of small arms weapon systems will continue to overmatch the evolving threat and address the needs of the Future Force, and where practical, enhance Current Force capabilities. The main effort in Project H21 is the Lightweight Small Arms Technologies (LSAT). LSAT will lighten the Soldier's load and provide improved battlefield mobility and reduced logistics burden to maximize operational utility and survivability, while maintaining or improving current levels of performance. Other efforts in H21 include advanced bullet designs, surveillance and tag/ mark munitions, and the assessment of stun, smoke, and other small arms delivered capabilities. All Joint Service Small Arms Program (JSSAP) efforts are based upon the Joint Service Small Arms Master Plan (JSSAMP), the Joint Capabilities Integration Development System's Small Arms Analyses, and the resulting Capabilities Development Documents of the Services. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), and the Defense Technology Area Plan (DTAP). This program is managed by the US Army Armament Research, Development, and Engineering Center (ARDEC), Picatinny, NJ. Work in this PE is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology) and PE 0603607A (Joint Service Small Arms Program). Transition paths have been established in coordination with Program Executive Officer (PEO) Soldier, Project Manager Soldier Weapons, Product Manager (PM) Crew Served Weapons, PM Individual Weapons, US Marine Corps PM Infantry Weapons, and PEO Special Programs, US Special Operations Command (SOCOM).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Lightweight Small Arms Technologies (LSAT): In FY06, conducted ammunition testing to validate models with measured values for chamber pressure, muzzle velocity, material strength, and functionality for both cased telescoped ammunition and caseless ammunition; conducted extensive evaluation of weapon action subcomponents as well as alternate materials to validate and update models with new data. In FY07, complete weapon and ammunition component evaluation and lab scale testing; integrate weapon and ammunition component designs into weapon system; integrate subsystem 3-D models into a fully functioning system level model for both cased telescoped and caseless applications; maximize modularity of components to facilitate future upgrades. In FY08, technologies enabling improved small arms lethality and utility and technical fire control will be advanced. Will fabricate prototype bullets based on these designs and conduct laboratory tests to validate improvements over legacy designs. Improved cartridge cases, materials, and higher energetic propellants will be fabricated and laboratory tested to determine interior ballistics. The best technical approach for use of surveillance (tag and mark) munitions will be determined in conjunction with weapon fire control systems. Current versus required capabilities for stun, smoke, and other small arms delivered capabilities will be assessed. Alternate methods of range finding, such as laser steering, will be advanced. In FY09, the best technical approach for surveillance, stun and smoke will be identified, fabricated, and assembled into cartridges for flight testing ballistics data collection. Improved ranging accuracy will be evaluated through the use of multiple pulse model averaging lasers and laser steering technology. Also in FY09, modular technology will be developed to enable real-time display of pertinent battlefield data through small arms fire control.	5490	6029	7008	7571
Small Business Innovative Research/Small Business Technology Transfer Programs		149		
Total	5490	6178	7008	7571

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602624A - Weapons and Munitions Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	123684	118331	40469	30663	30446	30510	31273	31549
H18	ARTY & CBT SPT TECH	12809	12932	14624	12190	14486	17129	17673	17724
H19	CLOSE COMBAT WEAPONRY	5909	7849	5457	7311	4511	1981	2025	2069
H1A	WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	86505	83815						
H28	MUNITIONS TECHNOLOGY	18461	13735	20388	11162	11449	11400	11575	11756

A. Mission Description and Budget Item Justification: This program element (PE) designs and develops improved weapons and munitions technologies to enable combat overmatch for the Future Force and, where feasible, for Current Force enhancements. Efforts in this PE result in increased system lethality and survivability with the potential for lower weight, reduced size, and improved affordability. Project H28 supports the Guided Blast and Guided Focused-Frag Explosively Formed Penetrator Warheads, for the Kinetic Energy Active Protection System (KEAPS), which develops munitions and countermeasures for Active Protection Systems (APS) to enhance survivability for lightly armored or very lightweight vehicles. Projects H18, H19, and H28 support the Common Smart Submunition effort, which designs and develops component technologies for next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems. Additionally, Projects H18, H19, and H28 support the Fuze and Power for Advanced Munitions efforts, which in tandem enables tailorable warhead effects for increased functionality and also designs and evaluates new on-board munition power systems with increased energy/power densities in order to extend the range and increase the lethality of future munitions. A major effort in project H18 is the Insensitive Munition (IM) Technologies Initiative, which is focused on reducing unplanned/accidental detonation of munitions. This work is related to and fully coordinated with IM work at the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD, (Program Element (PE)/Project 0602618/H80) and the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL, (PE 0602303/214). Project H1A funds congressional special interest items. Project H28 focuses on the design and evaluation of advanced warheads (shaped charge and Explosively Formed Penetrators (EFPs)); novel energetics/explosives; and high impetus, low flame temperature propellants to reduce wear on gun tubes. Most products of this PE transition to PE0603004A (Weapons and Munitions Advanced Technology) for maturation and demonstration. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is primarily performed by the Army Armament Research, Development, and Engineering Center at Picatinny Arsenal, NJ, as well as the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD, and the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	125267	35344	33361	33918
Current BES/President's Budget (FY 2008/2009)	123684	118331	40469	30663
Total Adjustments	-1583	82987	7108	-3255
Congressional Program Reductions		-895		
Congressional Rescissions				
Congressional Increases		84750		
Reprogrammings	-1583	-868		
SBIR/STTR Transfer				
Adjustments to Budget Years			7108	-3255

FY08 funds increased to support development of active protection system (APS) interceptor warheads.

Thirty-eight FY07 congressional adds totaling $81229 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($2876) Green Armaments Technology (GAT)
($1870) Armaments Information Assurance
($2493) Homeland/Perimeter Defense Technologies
($2492) TEMPER
($958) Seamless Data Display
($958) Active Coatings Technology
($1054) Adv Tech Lightweight Arm Sys-Rarefaction Wave Gun
($4217) Adv Materials & Processes for Armament Structures
($2493) Armament Sys Engineering & Integr Init (ASE12)
($2157) Electroconversion of Energetic Materials
($4410) Army Center of Excellence in Acoustics
($3738) Developmental Mission Integration
($4073) Engineered Surfaces for Wpns Sys Life Extension
($1581) Fatigue Odometer-Veh Comp & Gun Barrels Proj
($2204) Micro/Nano Systems Technology Research
($1773) Nanoparticle Dev for Energetic Mat/Prot Systems
($1869) Non-Nuclear Earth Penetrator Operational Prototype
($1869) Precision Manufacturing Initiative
($3738) Remotely Operated Weapons/Sensor Technology

($1342) Toxin Guard Research
($958) Transition Laser Engineered Net Shaping Technology
($1869) Armament Manufacturing Model/Science
($958) Civilian Military Incident Management (CMIM) Tool
($2492) Electrolytic Super-Capacitors, Polymer f/FCS App
($2827) Energetic Formulation and Fabrication
($3834) High Speed Data Communications System (HSDCS)
($1390) Improved Airborne Command and Control System (IACC
($3450) Integrated Command Operations Program (ICOP)
($958) Ltweight Munitions & Surveillance Sys for Unmanned
($2396) Parts-on-Demand for CONUS Operations
($2588) Plasma Acoustic Dazzier Denial Systems Initiative
($2061) Sculpted Transparent Armor
($1390) SOSSEC Demo only for Penn Army National Guard
($1054) Steering Guided Mun & Projectiles w/Microactuators
($1054) UGV Weaponization
($958) Weapon System Integration Force Protection Vehicle
($1869) Advanced Rarefaction Weapon Engineered System
($958) Hospital Emergency Planning & Integration

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602624A - Weapons and Munitions Technology**	**H18**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H18 ARTY & CBT SPT TECH	12809	12932	14624	12190	14486	17129	17673	17724

A. Mission Description and Budget Item Justification: This project conducts applied research on technologies to enable advanced munitions, submunitions, smart munitions, networked fires, fire control, combat support systems, cannon fires, and mortar fires in support of the Future Force and, where feasible, to enhance Current Force capabilities. Technology challenges include reducing artillery target location errors, providing real-time targeting data to fire direction centers, and enhancing functionality of sensor inter-networking to support information dominance strategies. Improved smart munitions are pursued to enhance Non Line-of-Sight (NLOS) capabilities and area denial capabilities. These munitions can be delivered by a wide range of munition/missile systems with significant increases in lethality effectiveness and number of kills per individual munition/missile to reduce logistic burden. Major efforts include: Common Smart Submunition (CSS), which designs and evaluates component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems; and an Insensitive Munition (IM) Technology initiative, which focuses on identifying, maturing, and applying technologies that will reduce unplanned, accidental, and/or sympathetic detonation of munitions in order to meet IM requirements. For gun propulsion systems, the focus of the IM effort is on designing barrier and venting technologies for existing and future gun propulsion systems and developing high energy, IM gun propellants at the sub-scale level for emerging gun programs. For warheads, this effort investigates venting mechanisms and IM liner technologies for existing and future explosive projectiles. In addition, the effort develops predictive models and simulations for IM technologies. Other efforts in this project include: Fuze and Power for Advanced Munitions, which researches and evaluates technologies that reduce munition size and add tailorable effects for advanced munitions; and Future Force Gun and Munition Technology, which matures leap-ahead concepts for future armaments, munitions, and energetics and exploits novel nano-structured metal/ceramic materials. In FY07, this project also researches high power microwave technology for use as non-lethal weapons. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This work is performed by the U.S. Army Armament Research, Development, and Engineering Center (ARDEC), at Picatinny, NJ, and the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Common Smart Submunition (CSS): In FY06, fabricated hardened breadboard electronic components; conducted sensor tower test/data collection; developed CSS models for analyzing/evaluating systems packaging, integration, and deployment scenarios; determined packaging architecture for CSS electronics; concluded options trades for go-forward design small enough for Unmanned Aerial Vehicle, missile, and projectile applications. In FY07, conduct full up integration of components/subsystems into prototype tactical submunition. Execute Technology Readiness Level (TRL) tests to evaluate and establish baseline performance in these critical areas: 1) sensors and algorithms (Autonomous Target Recognition - ATR, Simulated Computer Lab runs, Captive Flight Test - CFT); 2) Orientation and Stabilization (O&S) spin/stability performance (helicopter drop/spin tests); and 3) High-G survivability (shock tests, Soft Recovery System [SRS] tests). Evaluate Modeling and Simulation (M&S) analyses for carrier/submunition packaging, dispense, engagement, and effectiveness. In FY08, post-test operational performance metrics will be quantified and baselined as entrance criteria for 2nd System Design Review in Dec 2008; specifically the sensor transmit/receive performance, algorithm/ATR discrimination capability, O&S samara blade performance (slow and high speed deployments), and High-G survivability of components/sub-systems (sensor module, electronics, Safe and Arm [S&A] module, battery, O&S module. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H19 and H28, and PE/Project 0603004/232.	5493	2844	3208	

IM Technologies Initiatives: In FY06, demonstrated laboratory scale warhead venting designs; developed reactive flow models for downselected candidate explosives; fabricated and evaluated second iteration of propellants. In FY07, design full scale warhead venting; conduct experimental characterization and bullet impact/fragment impact (BI/FI) modeling of Non-Line-of-Sight Launch System (NLOS-LS); downselect most promising propellant formulations and conduct subscale demonstration of best propellant for ballistic and IM performance. In FY08, will show high lethality in a full scale prototype warhead venting and reactive liner design; will conduct sympathetic detonation (SD) modeling and experimental characterization of low order behavior. In FY09, will complete SD/BI modeling including low order response.	2092	3001	1050	250
Fuze and Power for Advanced Munitions: In FY06, conducted laboratory evaluations, and refined design for MEMS S&A components, Electronic Safe and Arm Devices (ESADs) and safety sensor designs. In FY07, integrate MEMS S&As and ESADs with sensors and continue laboratory, flight test of prox technologies, evaluation of integrated system to validate models. In FY08, will evaluate performance and safety of ESAD and MEMS sub-assemblies. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H19 and H28, and PE/Project 0603004/232.	3394	3292	3000	
FF Gun and Munition Technology (Lightweight Armaments Enhancement Program): In FY06, initiated test planning for successful FY05 approaches. Nanotechnologies for FF Armaments and Munitions: In FY07, investigate/characterize nanomaterial based powders for use with low energy initiation (LEI) concepts. In FY08, will conduct advanced concept investigations for Direct Write technologies (including lab demonstrations). (Direct Write Technologies involves placing a thin line of explosive (i.e., writing) onto a surface or chip for the purposes of reducing the size and weight of an explosive train/detonator.) In FY09, will investigate integration of developed Direct Write technologies into actual armaments systems and subsystems. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.	137	424		
High Powered Microwave - Non-Lethal (HPM-NL): In FY07, investigate a non-explosive HPM payload capable of being fired from a Line-of-Sight (LOS), Non-Line-of-Sight (NLOS), and Beyond-Line-of-Sight (BLOS) platform and will cause temporary or permanent electronic disruption with reduced collateral effects; conduct trade studies to establish design parameters; evaluate various HPM source technologies; establish target defeat metrics. Model various launch methods and subsequent performance characteristics. In FY08, will model component behavior and fabricate individual components of the system, and conduct component experiments for antenna, primer power, pulsed power, and microwave source and will model effects on infrastructure targets; will integrate results from infrastructure targets with battlefield effectiveness models. G-Hardened design will be evaluated to address structural integrity in a gun launch environment. Iterative exterior, interior, and terminal ballistics will be modeled for various delivery methods. In FY09, will commence integration of individual components and will model the integration of the combined system. Mechanical High-G design and electrical analyses will be performed in tandem to address electrical shielding effectiveness; will commence laboratory effects testing of an integrated laboratory prototype against relevant electronic materiel; results of testing will feed battlefield models to achieve improved battlefield modeling fidelity.		3206	5808	6935
G-Hardened Sensor Tech for Munitions: In FY06, began development of multi-mode integrated g-hardened sensor packages; characterized baseline sensor designs for survivability versus performance and performed gun launch experiments to demonstrate survivability of individual component technologies.	963			
Near Autonomous Unmanned Systems: In FY06, conducted system engineering and tradeoff analysis to identify the best technical approach to provide a remote armament capability for Armed Robotic Vehicle; began concept design and analysis of the ammunition handling system, the weapon, weapon mount, and control system. Conducted market survey to determine available fire control technologies that could be leveraged.	730			

Novel Propulsion Technology for Future Force: In FY08, will conduct modeling and simulation based study to drive formulation and configuration parameters for very high energy survivable gun propulsion systems. In FY09, will fabricate small samples and conduct subscale evaluations of the most promising propellants.			1558	2027
Direct Fire Lethality: In FY09, will initiate trade studies for next generation Kinetic Energy (KE) penetrator to maintain overmatch lethality of large caliber gun system(s) of FCS and Stryker Brigade Combat Team; will research the potential for alternate materials for KE penetrators; will initiate system engineering designs for course correction technology for application in 120mm long rod penetrators.				2978
Small Business Innovative Research/Small Business Technology Transfer Programs		165		
Total	12809	12932	14624	12190

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602624A - Weapons and Munitions Technology**	**H19**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H19	CLOSE COMBAT WEAPONRY	5909	7849	5457	7311	4511	1981	2025	2069

A. Mission Description and Budget Item Justification: This project focuses on conducting applied research and designing technologies for maneuver and fire support cannon armament systems in support of Future Combat System (FCS), the Future Force and, where feasible, to enhance Current Force capabilities. The project conducts research in technologies that will result in significantly greater lethality at longer ranges with more accurate delivery, significantly reduced logistics footprint, and reduced life cycle costs for ground combat platforms. Both hardware and analytical tools (software) are refined and used to assess performance, identify problem areas and formulate solutions. This project develops advanced multi-mode fuzing component, and directed energy weapons and munitions to defeat surface laid and buried mines and threat electronic systems. Countermine neutralization exploits Laser Induced Plasma Channel (LIPC) to defeat surface laid and buried mines and other threats; Non-Lethal Payloads for Personnel Suppression, which enables personnel suppression and area denial at BLOS ranges; Warfighter Technology for Future Operations, which refines advanced on-board munition power systems with increased energy/power densities, increased mission time, improved temperature performance, and reduced volume and weight for a variety of applications, and integrates and tests single and multiple Explosively Formed Projectiles (EFPs and MEFPs). The Near Autonomous Unmanned Systems effort designs and evaluates a remote weapon station optimized for high-reliability on an unmanned vehicle; Pulsed Laser System Technologies, which starts in FY08, conducts system engineering, designs, and evaluation of power and energy demands required for weaponizing LIPC onto a hybrid platform. Work in project H19 is related to, and fully coordinated with, efforts in projects H18 and H28 (also in program element (PE) 0602624A) PE 0602618A (Ballistics Technology), and projects 232 and L94 in PE 0600304A (Weapons and Munitions Advanced Technology). The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the Defense Technology Area Plan (DTAP). This work is performed by the U.S. Army Armament Research, Development, and Engineering Center (ARDEC), at Picatinny, NJ, and the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Non-Lethal Payloads for Personnel Suppression : In FY06, conducted laboratory and field testing to determine concentration levels of suppression payload to achieve desired effects against personnel; conducted dissemination test and initial health and environmental assessment. In FY07, verify effectiveness of the NL payload and its dissemination technique at the target area via a system flight test demonstration in relevant environments. (The round is not destroyed, but will follow a trajectory different from the disseminated NL payload submunitions. Thus, the round is not completely Non-Lethal, but the payload is.) Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.	1377	1725		
Mine neutralization: In FY06, conducted modeling & simulation to increase channel length of laser filamentation for Laser Guided Energy (LGE)/Laser Induced Plasma Channel (LIPC); evaluated different directed energy (DE) waveform types for effective defeat of surface laid and buried mines; conducted laser filamentation testing to determine laser parameters required for integration with high voltage energy or other Directed Energy (DE) waveforms. In FY07, integrate brass board laser with DE system(s) to demonstrate LGE technology; conduct laboratory testing to verify laser integration parameters and perform low level target effects testing for countermine. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.	2580	3611		
Fuze and Power for Advanced Munitions: In FY06, conducted laboratory evaluations and initial testing of preliminary designs on new	1952	695		

thermal and liquid reserve batteries and hybrid systems as power sources for current and future munitions. Common Smart Submunition: In FY07, will integrate component technologies (Multiple Explosively Formed and Single Explosively Formed Projectiles) for dynamic warhead tests using novel energetics in the combined effects warhead design. Airborne Test Bed (ATB) modifications and fabrication will be completed enabling sensor/sublet suspension from helicopter and cabling of electronics wiring harness for Captive Flight Tests (CFTs) and Captive Carry Tests (CCTs). Rapid downloading of test data for playback/goodness check hardware and processes will be analyzed, decided, and incorporated into test program. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H18 and H28, and 0603004/232.				
Near Autonomous Unmanned Systems (NAUS): This effort addresses the safe weapon operations and self security risk areas of NAUS. In FY07, complete detailed design of concept; fabricate and assemble breadboard components including the ammo handling system; conduct laboratory experiments to prove out interfaces between the weapon, mount, fire control, and ammo handling subsystems; continue design and checkout of the control system; and, define and validate the interfaces with an Armed Robotic Vehicle (ARV) through experimentation. In FY08, will fabricate and assemble prototype hardware; conduct laboratory evaluations to assess functionality of subsystems; and, simulate functionality in wireless operation mode. In FY09, will complete check out of system and integrate with robotic platform. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H18 and H28; 0602601/H91; 0602618/H03; 0602120; and, 0603005/515.		1752	1977	1999
Pulsed Laser System Technologies: In FY08, will evaluate power and energy demands required for weaponizing Laser Induced Plasma Channel (LIPC) onto a hybrid electric platform vehicle. Will also perform trade studies to determine vehicle/platform capabilities and limitations using a LIPC based weapon system. In FY09, will perform physics based modeling and simulation (M&S) to determine LIPC based platform limitations. Will also run M&S force on force scenarios to determine LIPC based weapon system effectiveness in the battlefield. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.			3480	2077
Ground Based Munitions Technologies: In FY09, urban technologies for ground based munitions will be evaluated for use with the Intelligent Munitions System (IMS). As part of this effort, a set of sensor suites will be optimized for the urban environment and emerging sensor modalities will be investigated. In addition, target engagement approaches from a ground based munition which can engage both personnel and light vehicles while minimizing collateral damage will be evaluated. Will evaluate the sensor concepts and recommend best approach for further development. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.				3235
Small Business Innovative Research/Small Business Technology Transfer Programs		66		
Total	5909	7849	5457	7311

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602624A - Weapons and Munitions Technology**	**H28**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H28	MUNITIONS TECHNOLOGY	18461	13735	20388	11162	11449	11400	11575	11756

A. Mission Description and Budget Item Justification: This project advances the state of the art for enabling munitions technologies supporting the Future Force and, where feasible, to enhance Current Force capabilities. The project focuses on achieving increased lethality using smaller and lighter weapon systems with smaller and lighter armaments by funding efforts that design and evaluate warheads, multipurpose blast/fragmentation/shaped charge, and Explosively Formed Penetrators (EFPs), high energy explosives, large-caliber gun propellants with barrel wear-reducing additives, energetics, and advanced materials/processes for warheads. Novel warhead architectures, new propellant techniques, and advanced material technologies are applied to produce smaller, lighter, more effective, multi-role warheads with advanced warhead liners to more efficiently defeat existing and projected targets. High-energy, high-density explosives are designed to increase lethality and optimize performance. New improved energetic materials provide numerous transition opportunities for weapon system upgrades. High-impetus propellant formulations, when coupled with technologies such as electrothermal chemical ignition, offer increased muzzle kinetic energy, precision ignition, and repeatability. This project funds Novel Energetic Materials for the Future Force, which matures advanced energetic materials with the ability to control energy release for precision munition and counter-munition applications; Hardened Combined Effects Penetrator Warhead Technology, which provides overmatch lethality using a single warhead capable of defeating armor, bunkers, personnel, and Unmanned Air Vehicles (UAVs). The Future Force Guns and Munition Technology effort designs and evaluates technologies for lighter weight 120mm gun components, lightweight nano-materials for UAVs, and the Common Smart Submunition effort which is coordinated with and complementary to the work performed in H19 and is focused on warhead performance. In addition, the Guided Blast Warhead and Guided Focused-Frag Explosively Formed Penetrator (EFP) efforts develop warhead technology critical to the Kinetic Energy Active Protection System (APS); Extended Area Protection and Survivability, which demonstrates the use of command-guided medium caliber projectiles for the interception and destruction of incoming rockets, artillery, and mortar rounds; and G-Hardened Sensor Technology for Munitions, which develops ground sensors hardened to resist the forces of gun-launch and ground impact. Work in project H28 is related to, and fully coordinated with, efforts in projects H18 and H19 (also in program element (PE) 0602624A), PE 0602618A (Ballistics Technology), and projects 232 and L94 in PE 0600304A (Weapons and Munitions Advanced Technology). Efforts under this project are consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This work is performed by the U.S. Army Armament Research, Development, and Engineering Center (ARDEC), at Picatinny, NJ, and the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD. The APS countermunition efforts are in support of the Tank Automotive Research, Development, and Engineering Center (TARDEC) under PE 0603005A (Combat Vehicle and Advanced Automotive Technology).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Mounted Combat System and Abrams Ammunition System Technologies (MAAST): In FY06, matured advanced propulsion charge for Line-of Sight Multi-Purpose (LOS-MP) munition and matured a robust combustible cartridge case design; statically tested Mid-Range Munition (MRM) multi-mode warhead designs and completed initial design and integration of counter active protection sytem (APS) for MRM. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.	3313			
Novel Energetic Materials for the Future Force: In FY06, selected multipurpose warhead as the system application for demonstration of novel energetic materials, and tested the metal pushing capability and simulated the blast performance of several candidate fills against an LX-14 baseline. Selected two explosives that exceeded that metal pushing and blast capabilities of LX-14 while remaining within LX-14	5740	6581		

cost. In FY07, bound the pressure and temperature characteristics of the novel energetic materials for warheads through additional testing and modeling of selected multi-purpose warhead designs; conduct analysis to determine performance/survivability characteristics compared to current systems with conventional energetics; conduct experiments with best-performing energetic materials in multipurpose warheads.				
Hardened Combined Effects Penetrator Warhead Technology: In FY06, incorporated enhanced blast explosives and advanced lethal fragmentation designs into hardened shaped charge warheads. Designed and developed Fast-Jet unitary shaped charge warheads to defeat combined Explosive Reactive Armor (ERA)/base armor targets with a single munition. In FY07, evaluate test results and refine and optimize warhead designs accordingly. Repeat in-process testing to confirm performance of optimized warheads. Perform advanced hardening design, advanced fragmentation/multipurpose energetic, and unitary hardened shaped charge ERA defeat demonstrations. In FY08, will demonstrate optimized blast fragmentation, optimized warhead penetration, and munition integrated objective hardened enhanced blast/frag warheads against a broad target set including armor, personnel, material, and fortified structures. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.	5537	4114	4250	
Future Force Gun and Munition Technology (Lightweight Armaments Enhancement Program-LAEP): In FY06, incorporated specific technologies, such as Composite Overwrap tube, Dual Autofrettage, Composite Recuperator, Advanced Muzzle Brake into two (2) full size gun components with significant weight reductions for system specific applications on 120mm direct fire weapons. Developed concepts for integration of technologies on Current Force systems. Fuze and Power for Advanced Munitions: In FY06, evaluated performance and investigated producibility of a hybrid munition power. Common Smart Submunition: In FY06, improved aerostability and hit accuracy of EFP warhead. In FY07, complete testing of LAEP gun components to TRL 6. Nanotechnologies for Future Force Armaments and Munitions: In FY08, will conduct an investigation of the use of Lightweight Materials Applications to unmanned aerial vehicles (UAV's); will conduct advanced concept investigations for direct write technologies (including lab demonstrations). (Direct Write Technologies involves placing a thin line of explosive (i.e., writing) onto a surface or chip for the purposes of reducing the size and weight of an explosive train/detonator.) In FY09, will integrate the best candidate technologies from the FY08 investigation into actual UAV Systems; will investigate integration of developed direct write technologies into actual armaments systems and subsystems. Efforts described here are coordinated and complimentary to related efforts in PE/Project(s): 0602624/H18 and H19, and PE/Project 0603004/232.	1871	361	1261	3023
Guided Blast Warhead: In FY06, the critical system interfaces were established, parametric studies were conducted using modeling and simulation (M&S) and validation testing. In FY08, the baseline warhead will be characterized through M&S and verification testing and demonstrated in near tactical environments. This work is coordinated with Unguided EFP Warhead work in PE0603004/Project 232.	2000		5000	
Extended Area Protection and Survivability (EAPS): In FY07, analyze and model advanced warhead and fuze designs; fabricate and test against static targets. In FY08, evaluate the effectiveness of a lethality round (the standard projectile envelope configured for an advanced warhead technology kill mechanism), and a course correction round (the standard projectile envelope containing course correction technology for increased accuracy). The final decision on the integration of the EAPS projectile will be based on the results of these two technology demonstrations. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.		1284	2958	
Guided Focused-Frag Multiple Explosively Formed Penetrator (MEFP) Warhead: In FY08, will mature warhead with Modeling and Simulation (M&S) and validation testing, and will characterize warhead against all classes of threats. In FY09, will characterize baseline warhead with M&S and verification testing, and demonstrate in near tactical environments. This work is coordinated with Unguided EFP Warhead work in PE0603004/Project 232			5000	3533
G-Hardened Sensors Technology for Munitions: In FY07, continue experimentation (begun in FY06 in 602624/H18) and baseline designs		1141	1919	1606

to ensure survivability of the more fragile sensor modalities such as acoustic and electro-optical. Initiate hardening sensor elements to withstand impact during deployment. Categorize integrated sensor packages and begin design and integration of a multi-modal sensor suite into an 81mm and 40mm form factor. In FY08, will conduct lab experiments and demonstrate survivability of individual and integrated component technologies in > 20kG environments based on metrics developed earlier. Will develop architecture for networking sensors from different G-hardened nodes for target localization. Will begin fabrication of hardware and demonstrate ruggedness of sensors through testing conducted with air gun experimentation. Will perform initial demonstration of miniaturized highly-integrated components imbedded in munitions to include 81mm mortars. In FY09, will refine integrated design approach and G-hardened packaging. Will demonstrate survivability of individual and integrated component technologies in > 30kG and demonstrate (through live fire of munitions) the remote deployment of fully integrated prototypes packaged into mortars and 40mm grenades. Will implement architecture for distributed, low complexity, and power efficient decentralized network fusion of multiple G-hardened nodes for target localization.				
Scaleable Warhead Technology: In FY09, will conduct modeling and simulation studies of warhead concepts for evaluation of scaleable baseline performance against multiple target set configurations. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0603004/232.				3000
Small Business Innovative Research/Small Business Technology Transfer Programs		254		
Total	18461	13735	20388	11162

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602705A - ELECTRONICS AND ELECTRONIC DEVICES**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	92221	81773	43391	45365	46983	46404	45870	46856
EM4	Electric Component Technologies (CA)	9392	11531						
EM6	HEATING AND COOLING TECHNOLOGIES (CA)	3834	2720						
EM7	POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)	39487	30757						
H11	BATTERY/IND POWER TECH	11567	11705	13662	13218	12847	11939	10669	10903
H17	FLEXIBLE DISPLAY CENTER	5973	4798	6066	6603	7163	7175	7289	7405
H94	ELEC & ELECTRONIC DEV	21968	20262	23663	25544	26973	27290	27912	28548

A. Mission Description and Budget Item Justification: This program element (PE) funds enabling capabilities for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities by researching and investigating technologies in areas such as electronic components, power components, frequency control and timing devices, and display technologies. The objective of the program is provide technologies to perform precision deep fires against critical mobile and fixed targets; to provide exceptional all-weather, day or night, theater air defense against advanced enemy missiles and aircraft; and enhanced communications and target acquisition for current and future Army systems. Project H11 funds research on advanced portable power technologies (batteries, fuel cells, hybrids, engines, chargers, and power management) that enable: safe, reliable, and cost effective power sources; reduced system power requirements and logistics burden; increased mission duration. Project H94 funds research in the physical sciences essential to all land combat systems that contain any of the following component technologies: electronics, photonics, flexible displays, micro electromechanical systems, imaging laser radar (LADAR), magnetic materials, ferroelectrics, microwave and millimeter-wave components, and electromechanical systems (engine generator sets). Project H17 supports research at the Flexible Display Center to enhance battlefield situational awareness, increased vehicle mobility, survivability, and lethality, while reducing acquisition and support costs. Supported capabilities include autonomous missile systems, advanced land combat vehicles, smart anti-tank munitions, electric weapons, secure jam-resistant communications, automatic target recognition (ATR), foliage-penetrating radar, and combat identification. It supports all of the science and technology thrust areas that employ electronic and portable power-source technology. Projects EM4, EM6, and EM7 fund congressional special interest efforts.

Work in this PE is related to and fully coordinated with efforts in PE 0602120A (Sensors & Electronic Survivability), PE 0602782A (Command, Control, Communications Technology), PE 0602709A (Night Vision Technology), PE 0602783A (Computer and Software Technology), PE 0603008A (Command, Control, Communications Advanced Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the Army Research Laboratory and the Army Communications and Electronics Research Development, and Engineering Center, Fort Monmouth NJ.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	91925	42175	41729	41917
Current BES/President's Budget (FY 2008/2009)	92221	81773	43391	45365
Total Adjustments	296	39598	1662	3448
Congressional Program Reductions		-5702		
Congressional Rescissions				
Congressional Increases		45900		
Reprogrammings	296	-600		
SBIR/STTR Transfer				
Adjustments to Budget Years			1662	3448

Twenty-nine FY07 congressional adds totaling $43994 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1726) E-Beam Reticle and Lithography Inspection
($959) Nanofluidic Electronic Sensor Tech for Def Applica
($2396) PEM Fuel Cell Quiet Tactical Generators
($958) Direct Methanol Fuel Cell Lifetime Imp Program
($1533) Mfg Tech Dev of Adv Components for High Power SSL
($1869) Compact Tactical Laser Program
($1150) Def Sys Modernization and Sustainment Initiative
($958) Micromachined Switches in Spt of Transformational
($958) Q-Band Millimeter Wave Power for TacSat Comms
($1438) Renewable Energy for Military Applications
($2637) Transcritical CO2 Environmental Control Unit
($1247) Soldier Fuel Cell System
($1534) Flexible Polymer Multilaminate Packaging
($1534) Weapons of Mass Destruction Marking Set
($2157) Adv High-Energy Rechargeable Lithium Air Battery
($958) Conformal Lithium for Polymer Belt Battery
($1054) Lithium Metal Air Battery
($1917) Novel Zinc Air Power Sources for Mil Apps
($958) Field-Ruggedized Mid-Range Dir Methanol Fuel Cells
($2875) Jet/Diesel-Fueled Military Fuel Cell System
($958) Miniature Tactical Energy Systems Development

($1917) Portable Solid Oxide Fuel Cell SOFC/JP8 Demo
($1869) Sold Port Fuel Cell Power-Using Solid Fuel Hyd Gen
($958) Thi Cylinder Iron Disulfide Primary Battery
($1438) Revolutionary 1.5V Alkaline
($958) Advanced Portable Power Institute
($1917) Non-Flam, High En Dens, Low Temp Warrior Battery
($1917) Portable Energy Devices
($1246) Pulse Tech Army Battery Mngt for Lithium Batteries

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602705A - ELECTRONICS AND ELECTRONIC DEVICES**	**H11**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H11 BATTERY/IND POWER TECH	11567	11705	13662	13218	12847	11939	10669	10903

A. Mission Description and Budget Item Justification: This project conducts applied research to identify, advance, and enhance emerging power generation, energy storage, and power management technologies for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. This project researches advancements in electrochemistry, energy conversion, and signature suppression technologies, including those for primary batteries, rechargeable battery hybrids, fuel cells, power management, and components for electromechanical power generation. There is a critical need for ultra-lightweight man portable power, chargers, and power management for the dismounted Soldiers. The Soldier Hybrid Power and Smart Chargers effort investigates high energy and high power density hybrid power source components including rapid recharging methods using smart chargers, fuel cell systems, and smart rechargeable batteries. It also investigates novel power management methods through low power design tools and software operating system dynamic power management. The Silent Mobile power effort funds research in power sources that are smaller and more fuel-efficient and in advanced cooling systems enabling tactical sustainability and survivability. Both efforts will provide future Soldiers and other future force platform applications low weight and volume, safe, reliable, cost-effective power sources, reduced system power requirements, increased mission duration and reduced cost and logistics burdens.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development and Engineering Command, Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Soldier Hybrid Power and Smart Chargers: Develop and evaluate hybrid power sources, rapid battery chargers, and power management technologies in order to decrease soldier load, increase power capabilities, and decrease battery costs. In FY06, developed and evaluated propane fueled small Stirling engine generator components for silent manportable (<10 kilograms) power 160 watts; designed and demonstrated a hybrid fuel cell power source with reformed methanol fuel. In FY07, investigate system-level smart chargers integrated with a quiet power source, including Stirling engines and fuel cells, for stand-alone charging; design and demonstrate ruggedized Soldier hybrid power source for 72 hour mission; investigate micro-reformer components for logistic fueled manportable power source. In FY08, will evaluate methanol fueled Soldier hybrid fuel cell power source for 72 hour mission at 700 watt-hours per kilogram; will investigate rugged JP-8 burners for solid oxide power sources. In FY09, will demonstrate JP-8 fueled Soldier hybrid solid oxide fuel cell; will demonstrate manportable 160 watt JP-8 linear free piston Stirling engine power source weighing less than 10 kilograms; will evaluate 250 watt reformed JP-8 fuel cell for battery charging.	7567	7294	6880	6751
Silent Mobile Power: Investigate component and system level power technologies that will provide higher energy, reduced weight, quiet, more fuel and cost efficient power generation sources, including silent mobile power sources, cogeneration cooling systems, and tactical power management systems. In FY06, investigated fuel cell reformer components for 1-2 kW system for scout vehicle silent watch; investigated and matured logistic fueled Stirling engine generator components for silent mobile (for vehicle/trailer platforms) power >1kW; evaluated integrated 2 kW fuel processing system operating on low-sulfur fuel. In FY07, evaluate components for 2 kW fuel processing system operating on high sulfur fuel (>300 parts per million sulfur); evaluate a preliminary prototype of a 1-2 kW Stirling	4000	4125	4782	3467

engine generator system on JP-8. In FY08, will demonstrate controlled operational testing in a laboratory environment of 1-2 kW Stirling engine generator on JP-8 fuel; will demonstrate controlled operational testing in a laboratory environment of 2 kW fuel cell generator on JP-8 fuel; will demonstrate a preliminary prototype cogeneration cooling system using waste heat from a quiet power source. In FY09, will mature system integration and controls in order to demonstrate 2 kW solid oxide fuel cell generator and 1-2 kW Stirling engine generator in relevant field environment; will demonstrate integrated power/cooling cogeneration system.				
Lithium Air Battery: Develop and investigate advanced materials, material processes, and electrochemical components that will produce a high energy density (>1,000 Watt-hours/kilogram) lithium air power source for soldiers. In FY08, will investigate lithium organic and inorganic materials and processes to produce highly conductive electrolytes to achieve greater than 0.5 mill-Amps/square centimeter current densities; will demonstrate prototype lithium air cells/batteries having energy densities greater than 800 Watt-hours/kilogram; will demonstrate material stability of lithium air cell components to achieve high shelf life (greater than one year). In FY09, will develop material and cell fabrication processes to produce high energy density, stable, safe lithium air battery; will demonstrate prototype lithium air cells/batteries having energy densities greater than 1,000 Watt-hours/kilogram.			2000	3000
Small Business Innovative Research/Small Business Technology Transfer Programs		286		
Total	11567	11705	13662	13218

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602705A - ELECTRONICS AND ELECTRONIC DEVICES**	**H17**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H17 FLEXIBLE DISPLAY CENTER	5973	4798	6066	6603	7163	7175	7289	7405

A. Mission Description and Budget Item Justification: This project funds the Army's Flexible Display Center (FDC). The objective of this project is to mature flexible display technologies toward Army applications thereby providing leap-ahead technology to our Soldiers. Flexible displays are inherently rugged (no glass), light weight, conformal, potentially low cost, low power, and hence offer enhanced and new capabilities across a broad spectrum of Army applications. Areas of investigation include: lightweight, low power, and rugged flexible displays. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL). Note: This project was previously funded in PE 0602705A project H94 and is a restructuring of ongoing research into a distinct project for visibility and management oversight.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
The objective of this research is to mature flexible display technology for future vehicle and future Soldier applications. The research is being conducted at the Flexible Display Center (FDC) at Arizona State University. Management will be conducted by ARL in collaboration with Natick Soldier Center, the FDC, industry, and other university partners. In FY06, designed, fabricated, and devised display drivers for reflective and emissive specimen displays (up to 4" diagonal). The 4" diagonal displays will be delivered for the FY07 Future Force Warrior (FFW) capstone demonstrations. In FY07, design and fabricate 4" diagonal active matrix reflective and emissive displays with enhanced resolution and functionality and begin to qualify the pilot line for displays up to 15" diagonal. In FY08, the FDC will deliver reflective displays up to 10" diagonal from the pilot line for the next generation Soldier Systems. The FDC will begin full color designs. In FY09, the FDC will deliver up to 10" diagonal reflective and emissive displays from the pilot line with increasing performance for next generation FFW.	5973	4666	4066	4603
Flexible display partnerships funded through the U.S. Diplays Consortium (USDC) for tools, process, and materials development that directly support the FDC. In FY08, will establish programs through the USDC that support the FDC with existing tool modifications, processes, related material, and device development. The programs will directly support the FDC and the Army's mission to develop flexible displays and manufacturing technology for flexible displays. In FY09, will mature the USDC programs that directly support the FDC and the Army's mission to develop flexible displays and manufacturing technology for those displays.			2000	2000
Small Business Innovative Research/Small Business Technology Transfer Programs		132		
Total	5973	4798	6066	6603

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602705A - ELECTRONICS AND ELECTRONIC DEVICES**	**H94**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H94 ELEC & ELECTRONIC DEV	21968	20262	23663	25544	26973	27290	27912	28548

A. Mission Description and Budget Item Justification: The objective of this project is to conduct applied research in electronics and electronic devices including opto-electronics to support advanced power and energy generation and storage; Command, Control, Communications, and Computers (C4); and Intelligence, Surveillance, and Reconnaissance (ISR) technologies for the Future Force. This research supports thrusts aimed at enhanced battlefield situational awareness; increased vehicle mobility, survivability, and lethality; reduced acquisition cost; and reduced operations and support costs. Areas of investigation include: low noise clocks and oscillators; lasers and focal plane arrays for eye-safe laser radar (LADAR) and standoff target acquisition sensors like forward-looking infrared (FLIR); micro-electromechanical systems (MEMS) for multi-function radio frequency (RF) applications as well as smart munitions; advanced RF modules to support radars and communications systems; high-temperature high-power inverter circuits for electric drives; prognostics and diagnostics to reduce logistics demands; micro-power generators and advanced batteries, fuel reformers, and fuel cells for hybrid power sources for individual Soldier and platform applications. The fabrication of novel structures on new electronic materials, such as langasite for oscillators or molecular beam epitaxy (MBE) of semiconductor superlattices and the hybridization of opto-electronic (OE) devices with electronics will be key enablers for more affordable opto-electronic devices with new capabilities. These fabrication techniques require a more complete understanding of fundamental properties, growth techniques, and processing of new materials. These new materials and structures also require the development of new design and layout techniques, more sensitive and flexible test and analysis capabilities, and new means of packaging to protect the devices and promote control of heat and atmosphere while enabling transport of signals and power. These challenges can only be overcome with judicious application of a basic understanding of the physics and chemistry of the electronic and opto-electronic processes. These projects serve to enhance the survivability, lethality, and mobility of future Army platforms by enhancing their survivability electronics suite; increasing ranges while decreasing time lines for target acquisition sensors; and evolving more efficient, controllable power sources, and displays. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Design and mature high performance antennas and antenna arrays for RF front-end architectures supporting multifunction radar and communication systems. This work also includes evaluation and validation of these prototype designs. Among the issues addressed in this antenna development are scanning techniques, broadbanding, beamforming, polarization, platform integration, and affordability. In FY06, assessed Electronically Scanned Antenna (ESA) requirements for Army communications. Designed and matured multiple apertures in Joint Service Communications bands that can be integrated into composite armor. Designed high sensitivity single millimeter wave (mmW) microbolometer detector for radiometry applications. In FY07, design Satellite Communication on the Move (SOTM) and Terrestrial communication antennas and evaluate early prototypes. Evaluate high sensitivity mmW microbolometer detector array. In FY08, will validate that these antenna prototypes can be integrated into Army platforms through simulations and laboratory validation. In FY09, will mature these designs based on the measured laboratory data and transition the work to Communications and Electronics Research, Development, and Engineering Center (CERDEC).	2449	2376	2698	2507
Investigate micro and nano technology for small low cost, highly reliable, RF MEMS switches, resonators, and filters for multifunction RF applications; design highly stable low-noise oscillators with low-acceleration sensitivity by integrating photonic resonators and	2807	2320	3456	3702

conventional microwave components to improve the capability of radar systems to detect slow moving targets; mature components and software for C4 technology; and perform research in advanced tactical software tools for mobile, ad hoc network access control, intrusion detection, and authentication techniques for the Future Force. In FY06, fabricated a full piezoelectric lead zirconium titanate (PZT) MEMS switch based ESA for missile seekers. Investigated initial phase of 1/f noise (pink noise) physics in resonators and optimize miniature dual-mode resonators with low-g sensitivity leading to high-g smart munitions. In FY07, initiate investigations of 1/f phase noise perturbations and dual-mode resonators for stabile oscillators; initiate fabrication of wafer-level packaging with a MEMS phase shifter process for multifunction RF applications; start characterization of stabilized oscillator dual-mode crystals with low hysteresis temperature effects. In FY08, will devise a process for wafer-level packaging with a MEMS phase shifter for multifunction RF applications and complete investigation of 1/f phase noise perturbations and dual-mode resonators for stable oscillators. In FY09, will investigate approaches for a wafer level antenna. Prepare and integrate passive RF electronics with ARL's RF MEMS switch fabrication process.				
Research, design, and investigate new component materials, structures, devices, and electromagnetic issues of millimeter wave (mmW) components and active devices, such as vacuum electronic (VE) devices and millimeter wave integrated circuits (MMICs), to achieve higher output power, power-added-efficiency, linearity, and dynamic range for increased operation and detection range in future systems, unmanned aerial vehicles (UAVs), Electronic Warfare (EW), radar, and Soldier systems. In FY06, fabricated, and evaluated high power (60 W) Q-band millimeter wave power module (MMPM) amplifier; investigated reliability of gallium nitride (GaN) devices under high temperature, fabricated second generation devices, and implemented packaging concepts with thermal modeling. In FY07, initiate characterization, analysis, and evaluation of high power (80 W) Ka-band MMPM; and inititate design and characterizion of GaN transmit/receive (T/R) and power amplifier modules. In FY08, will complete efforts on Ka-band MMPM and GaN modules. Will design low noise GaN amplifier integrated in mini-package and will analyze thermal properties for high power packaged amplifiers. In FY09, will design and fabricate integrated low noise and high power T/R package for antenna array.	3205	2415	3533	3205
Investigate eye-safe, scanner-less, 3-D imaging laser radar (LADAR) for both long-range reconnaissance and short-range unmanned ground and air vehicle applications. Investigate optical limiter designs with promising nonlinear materials in order to provide passive protection of Future Force electro-optic (EO) vision systems from damage from laser threat devices. In FY06, evaluated and selected a nonlinear limiting material class with large bandwidth and high optical density for extensive characterization in tandem limiter configuration and fabricated and evaluated an imaging LADAR using an image tube as a receiver. In FY07, use the image tube LADAR to evaluate obscured target detection through 3-D LADAR imagery in simulated UAV and ground-to-ground scenarios; transition LADAR architecture to CERDEC for integration into UAV EO payloads; show large-dynamic-range, broadband optical limiting in a tandem limiter configuration chosen to match that of the Tank and Automotive Research, Development, and Engineering Center (TARDEC) system demonstrator with single Charge Coupled Device (CCD) sensor; transition selected broadband nonlinear limiting material to TARDEC for integration into the system demonstrator. In FY08, will utilize TARDEC testing results on the system demonstrator to further maximize performance of materials for CCD protection and will fabricate an integrated solid-state version of the LADAR architecture for transition to CERDEC and Armaments Research, Development, and Engineering Center (ARDEC). In FY 09, will retro-fit the solid-state version of the ladar receiver into the image tube to obtain improved performance required by Aviation and Missile Research, Development, and Engineering Center (AMRDEC).	3174	2738	1871	1118
Investigate multi-color, passive infrared (IR), imaging focal plane arrays (FPAs) for long range target detection and identification. Investigate molecular beam epitaxy (MBE) growth techniques for the growth of mercury cadmium telluride (HgCdTe) on Silicon (Si) substrates for both the mid-wave infrared (MWIR) and long-wave infrared (LWIR) spectral region to significantly decrease the cost and to allow the development of large area arrays. Design and fabricate arrays for higher operating temperature. In FY06, fabricated large area	1729	2260	2175	2170

FPA with up to 1000x1000 pixels for LWIR; fabricated new detectors for higher operating temperature; and analyzed passive IR target and background signatures for advanced IR dual-band passive sensors. In FY07, research MWIR and LWIR FPAs with high operating temperatures of 180 Kelvin for MWIR and 120 Kelvin for LWIR. In FY08, will investigate multicolor (Short Wave IR (SWIR)/MWIR/LWIR) FPAs for enhanced range and detection. In FY09, will research polarization sensitive data collection and analysis for improved target classification and identification and explore FPAs with on-chip processing.				
Investigate a broad base of extremely quick, accurate, and novel photonic architectures to enable detection of hazardous substances to enhance Soldier survivability. Investigate the hybridization of OE devices with electronics for IR scene projectors and compact 3-D imaging. In FY06, evaluated MEMS photoacoustic sensor performance for feasibility as a trace-level chemical sensor. In FY07, explore possible chip-level technologies (Quantum/Interband Cascade Lasers, MEMS microphones, and MEMS actuators) for incorporation into MEMS photoacoustic chemical sensing system. In FY08, will characterize current biomimetic recognition elements using several laboratory analytic methodologies; will evaluate olfactory sensor based on integrated MEMS photoacoustic system; will characterize efficacy of molecular recognition elements devised using rapid directed evolution methodologies and will investigate multi-band IR 2-D arrays for scene generation. In FY09, will assess recognition elements as alternative biologically-inspired methods to produce advanced photonic and electronic structures and investigate hybrid techniques incorporating novel recognition elements and spectroscopic inspection and investigate highly compact OE transceivers for 3-D imaging.	904	505	2678	4063
Investigate, design, and fabricate MEMS based components to improve power generation and micro-cooling technology for both the dismounted Soldier and Future Force systems. In FY06, fabricated a MEMS based fuel pump and fuel injector devices; designed and fabricated reclaimed energy system for small engines; and fabricated micro-cooling systems capable of 250 W/cm2. In FY07, design and fabricate reclaimed energy systems for small engines; investigate methods to integrate MEMS based fuel/air delivery devices into small engines; and design and fabricate cooling systems that provide 500 W/cm2. In FY08, will investigate advanced MEMS cooling systems, will demonstrate MEMS components on a small system and will fabricate MEMS valves for high flow applications. In FY09, will fabricate a heteroscopic turbine cooler; and will investigate improved MEMS rotary pumps, MEMS valves, and high flow low power atomizers.	4675	4577	3355	4248
Investigate and evaluate prognostics and diagnostics (P&D) algorithms; design, fabricate, and evaluate MEMS and other sensors; and design, develop code, and evaluate database for the integration into decision systems to extend sensor rationalization and minimize downtime via condition-based maintenance. In FY06, fabricated multi-level high-g MEMS switch wafers for capturing sudden accelerations; evaluated sensors for advanced core-sensor suite, processor and transceiver in multi-node network; and fabricated tag brassboard to experimentally validate selected core electronics. In FY07, initiate reduction of MEMS switch reset voltage and design initial package; initiate evaluation of fault identification criteria and determine physics of failure modes. In FY08, will fabricate experimental core module applied to specific commodities. Module will entail a coded algorithms transceiver, core sensors, processor, and remote sensor interface. Will conduct preliminary experimentation on networked RF link and incorporate fault algorithms. In FY09, will implement cross-correlated algorithms in an open architecture P&D system and will conduct fault prognostic tests enhancing algorithms and user interface in an open architecture environment.	2675	2653	2888	2954
Investigate technology for advanced batteries, fuel reformers, and fuel cells to be used in hybrid power sources for future electromagnetic armor and smart munitions. Investigate and mature silicon carbide (SiC) power module technologies to enable compact high temperature (up to 150°C heat sink temperature) and high power density converters for motor drive and pulse power applications for the Future Force. In FY06, provided electrode/electrolyte materials technology for enhancing charge/discharge rate of advanced Li-ion batteries and investigated absorbents for removing sulfides in military fuel for fuel cells. In FY07, provide improved electrolyte for low temperature Li-ion batteries and sulfur-tolerant catalysts for logistic fuel processing for fuel cells. In FY08, will explore new technology for reserve	350	347	1009	1577

batteries and more stable sulfur tolerant catalysts. Will investigate and mature high-temperature (90° - 120°C) SiC power modules implemented in voltage-controlled SiC power devices for low power hybrid electric vehicle (HEV) power conversion. In FY09, will explore higher energy reserve battery materials and higher power Li-ion battery materials. Will investigate and mature high-temperature (90° - 120°C) SiC power modules for medium power conversion.				
Small Business Innovative Research/Small Business Technology Transfer Programs		71		
Total	21968	20262	23663	25544

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602709A - NIGHT VISION TECHNOLOGY**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	30464	36203	24391	25662	26355	26877	26890	26917
H95	NIGHT VISION & EO TECH	22509	23643	24391	25662	26355	26877	26890	26917
K90	NIGHT VISION COMPONENT TECHNOLOGY (CA)	7955	12560						

A. Mission Description and Budget Item Justification: This program element (PE) researches, designs, and applies core night vision and electronic sensor technologies to improve the Army's capability to operate in all battlefield conditions. The technologies funded in project H95 have potential to provide the Army with new, or enhanced, capabilities to see and target farther on the battlefield, operate in obscured conditions, and maintain a higher degree of situational awareness (SA). These technologies support Future Combat Systems (FCS), the Future Force, and, where feasible, exploit opportunities to enhance Current Force capabilities. This project will fund efforts that will determine the benefits of using fused long wave infrared (LWIR) and very near infrared (VNIR) imagery for the dismounted Soldier in all day/night visibility conditions and research component technology for transition to future Soldier systems. Techniques to be explored include: super resolution, non-uniformity correction, image fusion, analog to digital conversion, region of interest (windowing) and motion detection, all contained in a single chip, and low power electronics for both cooled and uncooled infrared. This project will fund efforts to perform research to dramatically reduce the time necessary to acquire targets, and collect intelligence data. Additional efforts include providing the capability to incorporate lightweight laser designators on small unmanned aerial vehicle (UAV) and unmanned ground vehicle (UGV) platforms and portable Soldier systems, and research new infrared (IR) FPA technologies for both cooled, high performance IR FPAs and uncooled, low cost IR FPAs. Sensor models will be created to accomplish trade studies, performance predictions, and also support constructive simulation/wargaming for analysis of alternatives. In addition, this project will focus on sensor modeling and simulation technology maturation in critical areas such as; modeling target acquisition tasks of search, detection, recognition, and identification for currently inadequate representations in military operations in urban terrain, specific targets, and moving targets; modeling representations for advanced sensor technologies. Multispectral sensor simulations will support end-to-end predictive modeling and evaluation of new technologies in a virtual environment. This project will assess and evaluate laser materials to produce a covert ladar system. Project K90 funds congressional special interest items.

Work in this PE is related to and is fully coordinated with PE 0602705A (Electronics and Electronic Devices), PE 0602712A (Countermine Technology), and PE 0603710A (Night Vision Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602709A - NIGHT VISION TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	31664	23907	24904	26310
Current BES/President's Budget (FY 2008/2009)	30464	36203	24391	25662
Total Adjustments	-1200	12296	-513	-648
Congressional program reductions		-138		
Congressional rescissions				
Congressional increases		12700		
Reprogrammings	-1200	-266		
SBIR/STTR Transfer				
Adjustments to Budget Years			-513	-648

Ten FY07 congressional adds totaling $12176 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1294) Enhanced Micro-Image Display Technology
($959) Minaturization Sensors for Small & Tactical UAVs
($1055) Advanced Multi-Spectral Fusion Sensors
($1055) Eyesafe Pulsed Fiber Laser for LADAR
($1055) Mid-Wave Infrared Sensor Technologies
($1725) Millimeter/Terahertz Imaging Arrays
($1055) Multispectrum Sensor Protection
($1294) Power Efficient Microdisplay Dev for US Army NV
($959) Sensor Solutions for Unattended Surveillance
($1725) Small Bus Infrared Materials Mfg - Silicon Alt

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602709A - NIGHT VISION TECHNOLOGY**	**H95**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H95	NIGHT VISION & EO TECH	22509	23643	24391	25662	26355	26877	26890	26917

A. Mission Description and Budget Item Justification: This project funds the design, and development of core night vision and electronic sensor technologies and components to improve the Army's capability to operate in all battlefield conditions. The technologies funded in project H95 have potential to provide the Army with new, or enhanced, capabilities to see and target farther on the battlefield, operate in obscured conditions, and maintain a higher degree of situational awareness (SA). These technologies support the Future Force, and, where feasible, exploit opportunities to enhance Current Force capabilities. The Soldier Mobility Vision System effort will determine the benefits of using fused long wave infrared (LWIR) and visible near infrared (VISNIR) imagery for the dismounted Soldier in all day/night visibility conditions and research component technology for transition to future Soldier systems. Techniques to be explored that enhance SA include: super resolution, non-uniformity correction, image fusion, analog to digital conversion, region, of interest (windowing) and motion detection, all contained on a single low power chip for both cooled and uncooled infrared. The Distributed Aided Target Recognition (AiTR) effort will develop the ability to dramatically reduce the time necessary to acquire targets and collect intelligence data. The Lightweight Laser Designator effort pursues technologies that enable the incorporation of lightweight laser designators on small unmanned aerial and ground vehicle platforms and portable Soldier systems. In an attempt to satisfy the Warfighter needs, for persistent surveillance and threat warning, increasingly complex sensors (e.g. large (2000 by 2000 pixel) single color FPAs, and multi-spectral) are required resulting in higher cost sensors systems. HgCdTe, the only mature material technology that can operate in the infrared from ~1-30 microns, is currently deposited on small-size, very costly CdZnTe substrates, which are solely available from one foreign source. Depositing HgCdTe on low cost substrates, e.g., silicon, will enable very large format FPAs, and multi-spectral sensors at costs not attainable with current technology. In addition efforts focus on sensor, modeling, and simulation technology maturation in the following critical areas: target acquisition tasks of search, detection, recognition, and identification in urban terrain; and accurate representations for advanced sensor technologies. Multispectral sensor simulations will support end-to-end predictive modeling and evaluation of new technologies in virtual combat simulations; advanced multifunction laser efforts assess and evaluate laser materials to produce a covert ladar technology. High Performance Small Pixel Uncooled Infrared Focal Plane Array efforts demonstrate the feasibility of smaller pixel, lower cost, uncooled technology for short range ground, and unmanned aerial vehicle sensors, head-mounted thermal imaging, and thermal weapon sights, cost effective targeting systems, distributed aperture sensor systems, driver vision sensors, and sensors for precision attack munitions.

Work in this program (PE) is related to and is fully coordinated with PE 0602705A (Electronics and Electronic Devices), PE 0602712A (Countermine Technology), and PE 0603710A (Night Vision Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Soldier Vision System Components: In FY06, completed development, evaluated, and delivered final configuration prototype components: low power color micro displays; Micro Channel Plate Complementary Metal Oxide Semiconductor (MCPCMOS) visible near infra-red sensor; variable density dichroic combiner/attenuator; and multi-spectral pixel-fusion processor; designed and fabricated a Soldier vision system components test-bed to conduct system architecture human factors studies; continued multi-spectral fusion data collection for image fusion metric; performed video frame rate selection power/latency trade: Selected and evaluated image fusion	5702	3953		

algorithm. In FY07, evaluate low power high performance large format night imager and pixel fusion processor for multi-spectral fusion on a head mounted low power color display; design and deliver prototype components with integrated fusion architecture including; head mounted opto-mechanical configuration and interface definitions, low power electronic configuration, and interface definitions, multi-spectral sensor, color display fusion algorithm implementation, and MCPCMOS/electron bombarded active pixel sensor system level performance comparison study.				
Distributed Aided Target Recognition (AiTR) Evaluation Center of Excellence: In FY06, evaluated multispectral and hyperspectral AiTR algorithm against difficult targets and urban/cluttered environments. In FY07, conduct phenomenology study of fusing multiple sensors against highly cluttered environments. In FY08, will conduct field tests to collect data on multiple sensors for fusing capabilities against cluttered environments. In FY09, will complete data collection efforts (archive and ground truth data); will evaluate data collected to determine optimal sensor fusion techniques.	1180	1389	1277	1238
Lightweight Laser Designators: In FY06, conducted laboratory demonstrations, assessed performance, hardened and refined laser design in order to transition the designs to laser manufacturers for brassboard fabrication. In FY07, evaluate the brassboard compact lasers and assess their capability to meet lightweight designator requirements.	2256	3631		
Low Cost High Resolution Focal Plane Arrays (FPA): In FY06, demonstrated increased dynamic range readout circuits for the FPA to simultaneously observe contents of a dark cave while standing outside in bright sunlight; demonstrated long-wave HgCdTe growth on low cost substrates in a large format with greater than 93 percent operability (e.g. percentage of functioning pixels on a FPA); demonstrated dual band, dual f-number, high resolution HgCdTe FPA; demonstrated a 640X480 uncooled array with a reduction in time constant (e.g. to reduce image smear, especially for unstabilized systems and seeker applications) from the current capability of 12 millisecond (ms) to 5 ms and a 50mK noise equivalent temperature difference (NETD). In FY07, demonstrate long-wave HgCdTe array in a 640x480 format with greater than 96 percent operability; demonstrate a 640X480 uncooled array, with a 5 ms time constant and a 35 mK NETD (e.g. to improve image quality/crispness). In FY08, will develop and evaluate 2-color midwave infrared /longwave infrared (MWIR/LWIR) with joint operability of greater than 90 percent and 96 percent respectively for both threat warning and enhanced situational awareness. In FY09, will integrate and refine sensor development to achieve an operability of greater than 95 percent/98 percent; will design near infrared/shortwave infrared (NIR/SWIR) with wavelengths from 2.5 microns into the visible (550-760 microns) for mini-unmanned aerial vehicle (UAV) applications.	8298	6788	4979	4980
Modeling, Measurements and Simulation Applied Research for Sensor Design and Evaluation: In FY06, designed, developed, and validated engineering model for fused, multi-spectral (mid-wave infrared/long wave infrared or infrared/image intensifier) imager; designed, developed, and validated improved measurement procedures for under-sampled and "super-resolved" imagers. In FY07, complete development and validation of third generation forward looking infrared simulation; update acquire family of sensor design models with metrics for the detection and discrimination of concealed weapons, and develop more robust detection and discrimination of personnel in urban environments. In FY08, will design and deliver an aided target recognition performance model for use in combat simulations; will develop a flash signature library and discrimination model for sensor design and combat simulations. In FY09, will develop and validate sensor performance model improvements to more accurately address moving targets, environmental effects such as glint (reflective components), weather, and complex clutter (foliage and urban structures); begin design of performance models for distributed and networked imaging sensor systems.	4226	4820	5108	5055
Advanced Multifunction Laser Technology: In FY08, will assess and evaluate laser designs and materials for a multi-function laser system, including laser designation, range finding, explosive detection, eye-safe LIDAR, and signal transmission. In FY09, will select laser material and architectures to produce multiple wavelength bands and pulse modulation formats for future laser-based systems; will			3050	3182

build a breadboard version of a compact multifunction laser system.				
High Performance Small Pixel Uncooled Focal Plane Array: In FY06, performed trade studies, modeling, and simulation to demonstrate the feasibility of high performance small pixel uncooled focal plane arrays. In FY07, design and fabricate pixel structures to verify design parameters; test and evaluate the pixel structures to verify sensitivity and noise predictions. In FY08, will fabricate and test the read out integrated circuit (ROIC) and optimize the pixel structures; will test and evaluate the various components and verify results via modeling and simulation. In FY09, will integrate the pixel structure with the ROIC and perform validation test and evaluation.	847	2857	3645	3368
Soldier Sensor Component and Signal Processing: In FY08, will assess and evaluate co-location of sensor focal plane array and processing resources on the same chip; will assess and evaluate high resolution low power pixel mosaic structure display for infrared, hyperspectral, and visible sensors; will conduct evaluation and design trade study of advanced adaptive light weight optics. In FY09, will complete co-location of sensing and processing resources on same chip allowing for immediate feedback of processing results to enable real-time clutter rejection for hyperspectral and multispectral applications; will complete design and fabricate demonstrator of advanced pixel mosaic, high resolution, low light visible sensor display; will fabricate and evaluate prototype advanced adaptive optics.			6332	7839
Small Business Innovative Research/Small Business Technology Transfer Programs		205		
Total	22509	23643	24391	25662

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602712A - Countermine Systems**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	26698	27135	21795	21922	22160	22333	22824	23327
H24	COUNTERMINE TECH	15262	19087	18979	19055	19263	19414	19841	20278
H35	CAMOUFLAGE & COUNTER-RECON TECH	2523	2757	2816	2867	2897	2919	2983	3049
HB2	COUNTERMINE COMPONENT TECHNOLOGY (CA)	8913	5291						

A. Mission Description and Budget Item Justification: This program element (PE) studies and develops applied technologies to improve countermine, signature management, and counter-sensors capabilities for the Future Force and where feasible, exploits opportunities to enhance the Current Force. Project H24 focuses on concepts and technologies with potential to improve detection and neutralization of mines and other threats both conventionally and electronically triggered from a safe distance using ground and air platforms. The goal of this project is to increase mine detection search rates, reduce false alarm rates, and achieve precision neutralization capabilities in support of sustaining the high operational tempo needed in Future Force operations. Working in conjunction with the US Army Engineering, Research and Development Center (ERDC), this project examines countermine phenomenology of surface and buried mines and booby traps. In addition, this project matures wide area airborne countermine sensor concepts for higher altitude, wider area coverage, higher probability of detection, and lower false alarm rate for airborne minefield detection operations. Project H35 examines signature management techniques for tactical operation centers and counter sensor techniques to reduce the reconnaissance capabilities of our adversaries as well as techniques to harden our own sensors against laser exploitation and damage. Project HB2 funds congressional special interest items. This PE supports DoD's Center of Excellence for Unexploded Ordnance which coordinates and standardizes land mine signature models; maintains a catalogue of mine signatures; and supports the evaluation of mine detection sensors and algorithms.

Work in this PE is related to and is fully coordinated with PE 0602709A (Night Vision and Electro-Optics Technology), PE 0603606A (Countermine and Barrier Development), PE 0603710A (Night Vision Advanced Technology), ERDC, and the US Marine Corps. This PE contains no duplication of effort within the Army, other Services, or the Department of Defense. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE will be performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/ Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA; the Army Corps of Engineer, R&D Center, Vicksburg, MI; and the Armaments Research, Development, and Engineering Center, Picatinny, NJ.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602712A - Countermine Systems**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	29171	22088	21965	21961
Current BES/President's Budget (FY 2008/2009)	26698	27135	21795	21922
Total Adjustments	-2473	5047	-170	-39
Congressional Program Reductions		-104		
Congressional Rescissions				
Congressional Increases		5350		
Reprogrammings	-2473	-199		
SBIR/STTR Transfer				
Adjustments to Budget Years			-170	-39

Three FY07 congressional adds totaling $5128 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($959) Small SAR Buried Mine Detection
($3115) Biological Detection of UXO and Land Mines
($1054) Mapping and Detection of Unexploded Ordnance

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602712A - Countermine Systems**	**H24**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H24 COUNTERMINE TECH	15262	19087	18979	19055	19263	19414	19841	20278

A. Mission Description and Budget Item Justification: This project examines new countermine technologies that use man-portable, ground-vehicular, and airborne platforms for detection, discrimination, and neutralization of individual mines, minefields, and other threats. These technologies support the Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. The goal of this project is to detect threats with a high probability, reduce false alarms, and increase operational tempo. This goal is achieved by performing data collection and evaluation of detection technologies to assess the effectiveness of various sensor combinations and signal processing/fusion algorithms. This project supports the Center of Excellence for Unexploded Ordnance, established to coordinate and standardize land mine signature modeling; maintain a catalogue of mine signatures; support the evaluation of mine detection sensors and algorithms; and support the work effort on the countermine environment with the Corps of Engineers. The Countermine Neutralization effort increases the potential for sustained rapid movement of tactical forces using stand-off neutralization technologies such as explosively formed projectiles (EFP), high power pulsed electro-optics for high order neutralization, or low order deflagration, high power focused microwaves, and other emerging technologies. Area Airborne Minefield Detection efforts characterize promising airborne sensor technologies, tested in a variety of environmental conditions, to support wide area minefield detection, and phenomenology studies provide the ability to predict and improve the performance of airborne and vehicular countermine systems across all operational environments using models that predict countermine sensor performance and Automatic Target Recognition (ATR) performance. Explosive Detection efforts provide short range standoff capabilities to detect explosives using chemical sensing methods in urban environments and route clearance scenarios.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center (CERDEC)/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA; the Corps of Engineers RD&E Center, Vicksburg, MI; the Armaments Research, Development, and Engineering Center, Picatinny, NJ; and the CERDEC Intelligence and Information Warfare Directorate, Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Center of Excellence for Unexploded Ordnance (UXO): In FY06, prepared report on "real-time" explosive specific detection technologies with recommendations on technologies for varying environments; coordinated requirements, integrated programs from different mission areas, and leveraged the capabilities in other government agencies, industry, academia, and the international community. In FY07, continue to establish standards for testing, modeling, and evaluating Counter UXO technologies and ensure that requirements are current and accurate, ensure that opportunities for leveraging technologies are identified and exercised, ensure that duplicative programs are identified and eliminated, and information on programs and progress is shared. In FY08, will coordinate programs across the joint services on the models being developed by respective DOD elements. In FY09, will review and evaluate standards for testing and modeling of UXO technologies.	500	478	500	500
Wide Area Airborne Minefield Detection: In FY06, modified and evaluated the brassboard sensor design against multiple backgrounds; performed additional data collections with modified sensors; continued refining mini clutter detection algorithms and modules. In FY07,	5670	7414		

research and complete brassboard sensor design and software development for a prototype UAV payload sensor; assess technical performance against an operational environment; develop sensor design/specifications, automatic target recognition (ATR) algorithms and performance models for subsequent system prototyping.				
Countermine Neutralization: In FY06, assembled cross-country acoustic-based mine confirmation and localization sensor data collection system(s); investigated landmine confirmation and localization signal processing and associated target recognition algorithms; conducted joint field data collections with precision mine neutralization breadboard systems and confirmation and localization sensor data collection systems. In FY07, integrate multiple standoff mine localization and neutralization technologies onto a platform; conduct field experiments against mines and other threats in realistic on- and off-route environments; and assess the effectiveness of the combined detection and neutralization technologies; evaluate high powered microwave technologies developed by the Army Research Laboratory as a neutralization candidate.	3837	4281		
Countermine Phenomenology Studies: In FY06, conducted site characterization and threat sensing field experiments to determine predictive capabilities of improved geo-environmental models; assembled signature database of mines and other targets of interest in desert and temperate backgrounds; integrated soil thermal/moisture models with vegetation and targeted models to create synthetic images to improve and accelerate automatic target recognition algorithm development; initiated computational test bed validation and developed operational parameter guidance on selected sensor modalities. In FY07, complete computational test bed validation for EO/IR sensor modality; develop an electromagnetic sensor modality simulation capability in the computational test bed.	3930	4528		
Sensors for Explosive Detection: In FY06, investigated field portable explosive detection sensor technology for data collection; focused on spectroscopic sensor development as well as signature studies of roadside and vehicle borne explosives. In FY07, conduct lab and field experiments of new Soldier-portable or vehicular mounted chemical detectors and evaluate performance. In FY08, will evaluate emerging technologies and compare results to sensor metrics (sensor sensitivity objectives, speed, explosive compound selectivity); will investigate and evaluate promising technologies e.g. (Ion Mobility, Laser Induced Breakdown Spectroscopy, and standoff explosive sensors operating in the terahertz spectrum region) for explosives and weapon cache detection.	1325	1934	2003	
Logistically Efficient Standoff Threat Neutralization: In FY08, will identify, conduct experiments, and evaluate technologies for the detection of surface, obscured, and buried threats. In FY09, will improve standoff capability for threat neutralization by investigating advanced directed energy techniques (burst lasers, focused high powered microwaves, plasma channel high voltage) and/or explosively formed munitions to achieve increased accuracy with reduced collateral damage and logistics burden.			6624	6175
Anti-personnel/Anti-Tank Mine False Alarm Reduction: In FY08, will investigate new sensor and signal processing component technology, such as low-cost, compact radar sensor, electro-optic sensors, and standoff acoustic technologies for ground based and airborne systems that will provide the warfighter inexpensive solutions to the standoff detection of the full spectrum of threats (artillery shells, explosively formed penetrators, underbody attacks, command detonated mines, traditional landmines) while on the move. In FY09, will investigate, integrate, and evaluate new low cost sensor products and phenomenologies including multispectral electro-optical sensors/detectors, scalar and vector magnetometers and ground penetrating radars for reducing false alarm rates and improving rate of advance.			7807	7151
Standoff Explosive Detection Systems: In FY09, will conduct studies in the areas of chemical, nuclear, and biosensors applied to the explosive detection problems; will investigate standoff chemical capabilities to selectively detect multiple explosives (RDX, TNT, C4, etc.) in both vehicle borne and stationary environments; will investigate non contact sensing techniques to extend standoff range to 30 meters (goal).				3200

Phenomenology Sensors: In FY08, will extend the electro-optic/infrared (EO/IR) models in the countermine computational test bed to cover full minefield sized images and selected urban areas; will complete large scale validation for the EO/IR models; will validate synthetic aperture radar electromagnetic model for small scale imagery. In FY09, will extend synthetic aperture radar (SAR) and the electromagnetic models to full minefield size images; will validate large scale model that includes ground penetrating radar (GPR), SAR, and EO/IR for countermine system performance predictions in a variety of real world environments.			2045	2029
Small Business Innovative Research/Small Business Technology Transfer Programs		452		
Total	15262	19087	18979	19055

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602712A - Countermine Systems**	**H35**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H35	CAMOUFLAGE & COUNTER-RECON TECH	2523	2757	2816	2867	2897	2919	2983	3049

A. Mission Description and Budget Item Justification: This project designs, researches, and investigates advanced signature management and deception technologies for masking friendly force capabilities and intentions. These technologies support the Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. Counter reconnaissance technology efforts will investigate advanced materials and processes for countering visual, infrared (IR), and spectral sensors; optical and electronic techniques for reducing the signatures of uncooled IR sensors used in the Future Force; modeling and simulation of the vulnerability of sensors to laser blinding; and new technologies to exploit or deny the enemy's use of reconnaissance sensors against friendly forces. Efforts for the protection for third generation sensors investigate new technologies to reduce the susceptibility of third generation dual band forward looking infrared (FLIR) to detection via optical augmentation. Technologies researched under this effort will include measures to reduce the optical cross section of the third generation dual band FLIR both intrinsically within the detector/dewar and externally in the sensor system and research appropriate threat sensing algorithms. Technologies to be investigated include the decentered field lens, wavefront coding, spectral filtering, and threat sensing algorithms.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this program element is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Low Cost Counter Reconnaissance Technology: In FY06, integrated new focal plane arrays and optics into a prototype uncooled infrared sensor and fabricated advanced paints and patterns incorporating spectral signature reduction, performed field experiments to validate optical augmentation and spectral signature reductions.	2523			
Protection for Third Generation Sensors: In FY07, investigate available dual band FPA/dewar technologies for signature reduction and integrate into sensors to conduct experiments. In FY08, will conduct experiments to select dual band sensor technologies for threat sensing algorithm research. In FY09, will select algorithm based upon prior analysis and measure performance; will downselect technologies for investigation and fabrication of reduced signature breadboard.		2211	2316	2367
Camouflage: In FY07, collect ground-to-ground hyperspectral background data, including thermal and thermal spectra of coatings already in the Spectral Camouflage Optimization of Patterns (SCOOP) database; survey existing 3-D models (e.g. Paint Map Optimizer and MUSES) for compatibility with SCOOP. In FY08, will select 3-D target geometry model and generate or adapt first 3-D computer model for use in SCOOP optimizations; will make appropriate modifications to SCOOP to permit use of 3-D target geometry; will continue database development for backgrounds and coatings; will evaluate means of utilizing satellite spectral data in lieu of ground-to-ground data. In FY09, will generate 3-D camouflage patterns, including visible and near infrared/shortwave infrared/mid wave infrared/longwave infrared for at least one target; will test in a virtual environment; will continue database development for backgrounds and coatings.		481	500	500

Small Business Innovative Research/Small Business Technology Transfer Programs		65		
Total	2523	2757	2816	2867

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	27549	40902	17426	17169	18574	18956	19373	19799
H70	HUMAN FACT ENG SYS DEV	16670	18650	17426	17169	18574	18956	19373	19799
J21	HUMAN FACTORS APPLIED RESEARCH CA	10879	22252						

A. Mission Description and Budget Item Justification: This program funds the investigation and evaluation of aspects of human factors engineering that may limit or improve capabilities of individuals and teams of Soldiers operating in complex, dynamic environments to enable maximizing the effectiveness of Soldiers and their equipment for mission success. Key research areas include sensing, perceptual, and cognitive processes, ergonomics, biomechanics and the tools and methodologies required to manage interaction within these areas and within the Soldiers' combat environment. Research is focused on decision-making; human robotic interaction; crew station design; improving Soldier performance under stressful conditions such as time pressure, information overload, information uncertainty, fatigue, on-the-move and geographic dispersion; and enhancing human performance modeling tools. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of Soldiers, with particular emphasis on Soldier and equipment interaction. Application of advancements and tools yields reduced workload, fewer errors, enhanced Soldier protection, user acceptance and allows the Soldier to extract the maximum performance from the equipment. Work in this program element (PE) is related to, and fully coordinated with, efforts in PE 0602601A (Combat Vehicle and Automotive Advanced Technology), PE 0602786A (Warfighter Technology), PE 0602120A (Sensors and Electronic Survivability), PE 0602784A (Military Engineering Technology), PE 0602783A (Computer and Software Technology), PE 0602308A (Advanced Concepts and Simulation), PE 0603005A (Combat Vehicle and Automotive Technology), PE 0603710A (Night Vision Advanced Technology), PE 0603015A (Next Generation Training and Simulation), and PE 0603007A (Manpower, Personnel, and Training Advanced Technology).The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	28420	18858	18312	18450
Current BES/President's Budget (FY 2008/2009)	27549	40902	17426	17169
Total Adjustments	-871	22044	-886	-1281
Congressional Program Reductions		-156		
Congressional Rescissions				
Congressional Increases		22500		
Reprogrammings	-871	-300		
SBIR/STTR Transfer				
Adjustments to Budget Years			-886	-1281

Four FY07 congressional adds totaling $21566 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1917) Manpower & Personnel Integration (MANPRINT)
($1054) Team Perf & Optimization in Agent/Human Agent Team
($2492) High Optempo Performance Soldier Training
($16103) Leonard Wood Research Institute

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY**	**H70**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H70 HUMAN FACT ENG SYS DEV	16670	18650	17426	17169	18574	18956	19373	19799

A. Mission Description and Budget Item Justification: The goal of this project is to maximize the effectiveness of Soldiers in concert with their equipment, in order to survive and prevail on the Future Force battlefield. Major efforts in this project include research to identify sources of stress, potential stress moderators, intervention methods, adaptive learning, and supporting information technology to reduce uncertainty and improve decision quality for leaders and teams engaged in Command and Control (C2) planning and execution; enhancement of human performance modeling tools to optimize Soldier machine interactions for Future Force Warrior (FFW) and Future Force Systems and the collection of empirical data on human perception (vision and hearing) to support the development and validation of human and system performance models; investigations on the effects on Soldier performance from integration of advanced concepts in crew stations designs; the identification, assessment, and mitigation of the effects of vehicle motion on Soldier performance; investigations to determine interface design solutions for brigade combat teams (BCT) information systems that enhance situational understanding and decision cycle performance; identification and quantification of human performance measures and methods to address future warrior performance issues; and improvement of human robotic interaction (HRI) in a full mission context. The barriers to achieving the goal include incomplete Soldier performance data and models of the new missions, organizations, and new and complex technologies transforming the Army. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of Soldiers, with particular attention on Soldier and equipment interaction. The resulting data are the basis for weapon systems and equipment design standards, guidelines, handbooks, and Soldier training and manpower requirements to improve equipment operation and maintenance. Application of advancements yields reduced workload, fewer errors, enhanced Soldier protection, user acceptance, and allows the Soldier to extract the maximum performance from the equipment. Work in this project is conducted in cooperation with Tank and Automotive Research, Development, and Engineering Center (TARDEC); Natick Soldier Center (NSC); Communications-Electronics Research, Development, and Engineering Center (CERDEC); Simulation and Training Technology Center (STTC); Engineer Research and Development Center (ERDC); Army Research Institute (ARI); and Army Materiel Systems Analysis Activity (AMSAA). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Identify sources of usability deficiencies and mismatches between Soldier capabilities and technological advances and provide tools to enable adaptive learning, reduce uncertainty, and increase situational awareness to improve decision quality for leaders and teams engaged in Command and Control (C2) planning and execution. In FY06, refined decision aids to optimize visualization and information sharing requirements and investigated the usability and effectiveness of interactive technology for immersive training scenarios. In FY07, validate a suite of tools to improve C2 capabilities in uncertain and urban environments; and conduct cognitive task analysis of multi-player training modules. In FY08, will assess team performance while performing multiple tasks and functions occurring simultaneously when using integrated Intelligence, Surveillance, and Reconnaissance (ISR) technologies in uncertain situations. Will transition a report to the Simulation and Training Technology Center (STTC) on the ability of cognitive readiness metrics to predict performance in multi-user simulation implemented by the School for Command Preparation, Ft Leavenworth. In FY09, will determine methods to measure such attributes as motivation, mental resiliency, adaptability, and psychomotor skills that are needed for successful performance for the Future Force. These methods will be incorporated into the cognitive fight-ability model-based evaluation tool for use within the acquisition and	3959	4437	4095	3855

system design process as a candidate information system to recommend design modifications before prototypes are developed.				
Enhance human performance modeling tools to optimize Soldier machine interactions for FFW and Future Force. Collect empirical data on human perception (vision and hearing) to support the development and validation of human and system performance models. In FY06, incorporated ability to model human performance in joint operations with the Improved Performance Research Integration tool (IMPRINT 8 (Pro)); provided data to the Army Night Vision and Electronic Sensors Directorate (NVESD) to develop an object-recognition-based metric for the evaluation of algorithms for fusing imagery from multiple wavebands compared with the component, single-waveband imagery, and determined the feasibility of eye-movement data as a measure of effectiveness (MOE) of fusion algorithms. In FY07, identify and apply analysis metrics aimed at distinguishing performance of teams embedded within system-of-system (SoS) and joint operations; create and distribute a protected web-based repository of human performance models used in Manpower and Personnel Integration (MANPRINT) analyses; model terrain-hazard detection that integrates terrain-hazard detection data by human and machine-vision algorithms. In FY08, will incorporate stressor algorithms contributed by other Services into IMPRINT Pro, will re-verify and distribute the tool. Will collect human performance data using head-mounted, dual waveband sensors for room-clearing, and other operations in urban environments. In FY09, will verify and distribute linked basic task, cognitive and human motion models to the human systems integration community and platform developers. Will validate approach to modeling body size increase due to clothing. Will transition data to NVESD to verify metrics for the evaluation of algorithms for fusing imagery from multiple-waveband sensors.	2194	3115	3025	2535
Investigate effects on Soldier performance from integration of advanced concepts in crew stations designs. Identify, assess, and mitigate the effects of vehicle motion on Soldier performance. In FY06, extended mitigation solutions to a broad cross section of ride problems and integrated with multimodal display and control approaches for a comprehensive solution. In FY07, leverage lessons learned from Crewstation Integration and Automation Testbed (CAT) experimentation to generate recommendations to improve Soldier performance using drive-by-wire systems and identify and evaluate concepts for advanced visualization and auto-adaptive driving aids. In FY08, will explore techniques to improve Soldiers' ability to simultaneously perform visual scanning for targets and mobility-related tasks and will transition recommendations to TARDEC. In FY09, will determine Soldier machine interface design recommendations to enable the local area security function and the optimization of performance in mixed autonomous driving environments.	2108	2100	2100	2100
Investigate and determine interface design solutions for maneuver team information systems that enhance situational understanding and decision cycle performance. Identify, mature, and quantify human performance measures and methods to address future warrior performance issues. In FY06, transitioned display design guidelines to the Future Combat Systems Manned Integration team and the FFW technical program office based upon the experiment and model results. In FY07, mature physics-based models of human locomotion to predict Soldier mobility and range of motion; investigate individual Soldier physical and cognitive performance using prototype FFW Soldier systems; and link human performance predictor variables to dismounted Soldier performance metrics. In FY08, will explore the effects of advanced technologies, weight distribution, and focusing on small arms shooting performance and incorporate data to refine Soldier small arms shooter model. In FY09, will explore advanced technologies to identify improvements in dismounted squad performance; and will transition the small arms shooter model to the FFW program.	4509	5009	4538	4879
Improve human robotic interaction (HRI) in a full mission context for aerial and ground unmanned vehicles (UVs). In FY06, conducted empirical investigations of multitasking effects on HRI scaleable interfaces for mounted and dismounted Soldiers, multimodal and 3-D operator control units (OCUs), and adaptive automation. Collected data on OCU concepts during field experimentations and transitioned results to the TARDEC; and investigated HRI implications of mixed asset teaming concepts in realistic simulation and field experiments. In FY07, address Soldier-robotics team performance for mounted-dismounted combined arms missions using models and metrics with the goal of identifying optimal HRI interfaces for particular operational contexts; utilize metrics and diagnostics based on field studies and simulation experiments to determine optimal span of control and adaptive automation for UVs during FFW and Future Force missions. In	3900	3910	3668	3800

FY08, will transition HRI modeling results and design guidelines for automation and interface design and provide empirically-based recommendations for improving teaming performance to TARDEC; will contribute to data collection and HRI analysis of TARDEC's field experiments using multiple UVs to validate workload reduction and performance effects. In FY09, will develop multimodal and performance based adaptive automation interfaces to control multiple, non-heterogeneous, aerial, and ground robotic systems.				
Small Business Innovative Research/Small Business Technology Transfer Programs		79		
Total	16670	18650	17426	17169

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602720A - Environmental Quality Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	17570	19605	15809	15223	14925	14896	14965	15092
048	IND OPER POLL CTRL TEC	2748	2977	2996	3044	3076	3099	3167	3237
835	MIL MED ENVIRON CRIT	2949	3220	3268	3320	3355	3380	3454	3530
895	POLLUTION PREVENTION	3264	4542	3728	4062	3817	4011	4099	4189
896	BASE FAC ENVIRON QUAL	6979	6987	5817	4797	4677	4406	4245	4136
F35	Environmental Quality Applied Research (CA)	1630	1879						

A. Mission Description and Budget Item Justification: The objective of this applied research program element is to provide technologies that support the long-term sustainment of Army training and testing activities by improving the Army's ability to comply with requirements mandated by federal, state, and local environmental/health laws reducing the cost of this compliance. This program provides the Army with capabilities to decontaminate or neutralize Army-unique hazardous and toxic wastes at sites containing waste ammunition, explosives, heavy metals, propellants, smokes, chemical munitions, and other organic contaminants; as well as technology to avoid the potential for future hazardous waste problems, by reducing hazardous waste generation through process modification and control, materials recycling, and substitution. This program matures technologies to predict and mitigate range and maneuver constraints associated with current and emerging weapon systems, doctrine, or regulations. Research is transitioned to PE 0603728A (Environmental Quality Technology Demonstrations). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research, and Development Center, headquartered at Vicksburg, Mississippi, the Center for Health Promotion and Preventive Medicine located at Aberdeen, Maryland, and the Army Research Laboratory located at Aberdeen, Maryland, execute the project work.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602720A - Environmental Quality Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	17859	17923	17131	16650
Current BES/President's Budget (FY 2008/2009)	17570	19605	15809	15223
Total Adjustments	-289	1682	-1322	-1427
Congressional Program Reductions		-75		
Congressional Rescissions				
Congressional Increases		1900		
Reprogrammings	-289	-143		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1322	-1427

One FY07 congressional add totaling $1821 after adjustment for Congressional Undistributed Reductions was added to this PE.

($1821) Chemical Materials and Environmental Modeling Proj

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602720A - Environmental Quality Technology**	**048**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
048 IND OPER POLL CTRL TEC	2748	2977	2996	3044	3076	3099	3167	3237

A. Mission Description and Budget Item Justification: The objective of this applied research project is to provide technologies to enable the Army to reduce or eliminate environmental impacts both in the United States and abroad. These technologies reduce the impact of legal and regulatory environmental restrictions on installation facilities, training and testing lands and ranges, as well as avoid fines and facility shutdowns within the United States and reduce environmental impacts to the warfighter abroad. New and innovative technologies are essential for the effective control and reduction of military unique hazardous and non-hazardous wastes on military installations worldwide. Efforts include a focus on the impacts of new materiel that will enter the Army inventory within the next decade and beyond. This project focuses on industrial pollution sources from production facilities, facility contamination, and other waste streams providing compliance through sustainable environmental protection technologies. Efforts abroad include a focus on technologies to provide deployed forces with environmentally safe and cost effective technologies and/or processes to achieve maximum diversion, minimization, or volume reduction of basecamp/field waste. Additional work is focused on environmental risk assessment for ranges. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Industrial Compliance and Pollution Prevention Readiness: In FY06, matured bench treatment technologies, isolated and characterized common acetogens capable of RDX degradation and developed in situ bioremediation methods for ammonium perchlorate in soils and groundwater. In FY07, maximize adhesive and agglomerative properties of cellulosic component and will transfer polymer component to reduce barrier/fortification requirements. Initiate reductive treatment/transformation studies for Dinitro Anisole (DNAN) and Methyl Nitro para Aniline (MNA), and use structural activity analysis to predict fate and treatment effectiveness. Develop improved physics-based algorithms for blast and small arm noises though comprehensive measurements and application of non-linear wave steepening and time/frequency modeling. In FY08, will complete development of a Structural Activity Relationship (SAR) Predictive Model for insensitive munition treatment kinetics and will begin research in chemical/physical characteristics of fugitive industrial particulates. In FY09, design dose-response metrics for low frequency, peak pressure from blast noise on ranges and characterize pathways of fugitive industrial particulates.	2748	2928	2996	3044
Small Business Innovative Research/Small Business Technology Transfer Programs		49		
Total	2748	2977	2996	3044

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602720A - Environmental Quality Technology**	**835**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
835 MIL MED ENVIRON CRIT	2949	3220	3268	3320	3355	3380	3454	3530

A. Mission Description and Budget Item Justification: The objective of this applied research project is to provide quantitative means to determine the environmental and human health effects resulting from exposure to explosives, propellants, and smokes produced in Army industrial, field, and battlefield operations or disposed of through past activities. The end results of this research are determinations of acceptable residual Munitions Constituents (MCs) and Munitions and Explosives of Concern (MECs) contaminant concentration levels that minimize adverse effects on the environment and human health This research is supported by the previously developed Army Risk Assessment and Modeling System (ARAMS) that links models and databases of expected result and transport to the exposure and effects of explosives and their degradation by-products. The Long-Term Monitoring program reduces or eliminates the costly and lengthy operation of off-site analyses and enhances overall monitoring capabilities by providing continuous/autonomous detection/analysis. The program of Characterization/Assessment of Distributed Source MCs on ranges yields knowledge and technologies to quantify MC transport and fate in terrestrial range environments. New research in toxicogenomics, nanomaterial technologies, and computational/molecular modeling tools for toxicity and exposure assessment further reduces the uncertainty associated with both the probability of exposure and the ultimate effect if exposed. Interim products are U.S. Environmental Protection Agency approved health advisories and criteria documents to be used in risk assessment procedures. The Army uses these criteria during negotiations with regulatory officials to set scientifically and economically appropriate cleanup and discharge levels at Army installations. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, manages execution of the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
FY06, identified rapid, statistically based sampling and innovative analytical methods and protocols for MCs assessment on Army ranges, identified novel contaminant extraction and field measurement methods for on-site long term monitoring (LTM) and designed a computational biology virtual simulation for predictive toxicology for mammalian organisms. In FY07, will identify novel contaminant detection systems and measurement protocols for near-real-time, on-site LTM, integrate a distributed source contaminant transport model into the ARAMS, and further refine computational biology virtual simulations. In FY08, will design a laboratory-scale gene signature array microchip sensor, evaluate field negative ion miniature mass spectrometry for detection of MCs, define statistically valid range characterization/sampling protocols for MC sources, construct a toxicogenomic assessment framework as a modeling platform, identify methods for computational chemistry prediction of effects of water dissolved explosives, and identify analytical approaches to characterize nanomaterial properties to support toxicological and remediation approaches. In FY09, will evaluate LTM in situ biosensor technologies for direct push wells, finalize protocols for MC residue reduction, complete mathematical modeling of toxicity and effects due to existing, well characterized MECs and devise computational chemistry methods for the prediction of reactivity, and toxicity of water dissolved explosives and decomposition products. Will identify exposure quantification metrics for select representative nanomaterials. Will initiate a common framework to consolidate tools for comprehensive, multi-stressor range environmental risk assessments.	2949	3140	3268	3320
Small Business Innovative Research/Small Business Technology Transfer Programs		80		
Total	2949	3220	3268	3320

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602720A - Environmental Quality Technology**	**895**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
895 POLLUTION PREVENTION	3264	4542	3728	4062	3817	4011	4099	4189

A. Mission Description and Budget Item Justification: The goal of this project is to provide energetics/munitions technologies required to reduce/eliminate the environmental footprint resulting from the manufacture, maintenance, use and surveillance of Army ordnance. This program matures revolutionary technologies to eliminate or significantly reduce the environmental impacts that threaten the sustainment of energetics production and maintenance facilities and training ranges. The project supports the transformation of the Army by ensuring that advanced energetic materials required for the Future Combat System (FCS) high-performance munitions (gun, rocket, missile propulsion systems, and warhead explosives) are devised to meet weapons lethality/survivability stretch goals in parallel with, and in compliance to, foreseeable sustainment requirements. Specific technology thrusts include environmentally-benign designer energetic molecules engineered by molecular modeling and simulation using Department of Defense (DoD) High-Performance Computing resources; novel energetics that capitalize on the unique behavior of nano-scale structures; chemically engineered explosive and propellant formulations produced with minimal environmental waste, long-storage lifetime, rapid/benign environmental degradation properties, and efficient extraction and reuse; and fuses, pyrotechnics, and initiators that are free from toxic chemicals. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP), and supports the Army Strategy for the Environment. Work in this project is performed by the Research, Development, and Engineering Command's (RDECOM) Army Research Laboratory (ARL), Aberdeen, MD, in collaboration with the Armaments Research, Development, and Engineering Center (ARDEC), Picatinny Arsenal, NJ, the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), Huntsville, AL, and the Edgewood Chemical Biological Center (ECBC), Edgewood, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Rocket and Missile Propellants: In FY06, conducted small-scale testing of new environmentally benign prototype rocket propellants and engine concepts. In FY07, characterize decomposition products and environmental properties of new propellants. In FY08, will model performance of propellant-engine combinations. In FY09, will optimize and evaluate performance of propellants in new engine. Conventional Ammunition: In FY06, modeled ten new explosives and selected five for gram-scale synthesis and property evaluation. In FY07, synthesize and evaluate five new low-toxicity explosives in gram-scale, and scale-up synthesis of select materials for performance and environmental evaluation. In FY08, will refine green chemistry synthesis procedures, and will perform full chemical and physical characteristic evaluation of new explosives. In FY09, will model performance of new environmentally benign explosives in weapons systems. Pyrotechnics: In FY06, refined perchlorate-free pyrotechnic formulations and composition processing, and identified and evaluated non-polluting manufacturing processes for pyrotechnic and explosive manufacture. In FY07, evaluate environmental characteristics, performance and compatibility of pyrotechnic candidates. In FY08, will optimize low-toxicity smoke formulations. In FY09, will investigate environmentally sustainable simulators, flares, delays and signals.	3264	4414	3728	4062
Small Business Innovative Research/Small Business Technology Transfer Programs		128		
Total	3264	4542	3728	4062

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602720A - Environmental Quality Technology**	**896**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
896 BASE FAC ENVIRON QUAL	6979	6987	5817	4797	4677	4406	4245	4136

A. Mission Description and Budget Item Justification: The objective of this applied research project is to provide environmental risk assessment, analysis, monitoring, modeling, and mitigation technologies to support sustainable use of the Army's facilities, training lands, firing ranges, and airspace to reduce or eliminate environmental constraints to military missions. This project provides the Army the technical capability to manage, protect, and improve the biophysical characteristics of training and testing areas needed for realistic ranges and training lands to accommodate the Current and Future Force. Technologies within this project enable users to match mission events and training schedules with the resource capabilities of specific land areas and understand how the use of those resources effect mission support and environmental compliance. The project provides advanced methods and technologies to restore lands damaged during training activities and allow sustained use of installation facilities and training land resources. The project also provides tools and technologies to avoid training restrictions and costs due to training and testing noise. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Threatened and Endangered Species (TES) Management to Reduce Operational Constraints: In FY06, completed spatial assessment technology for high priority species on Army lands and mature new inventory and monitoring protocols for select species to reduce TES management costs. In FY07, complete new techniques for preparation of population goals on Army lands to ensure the Army is responsible for its fair share of species recovery. Complete initial groundwork in improving species at risk (SAR) detection capability. In FY08, will complete projects identifying effects of noise and physiological stress of transient training activities on the Indiana Bat and Gopher Tortoise, research in support of a Candidate Conservation Agreement for Gopher Tortoise, and enhanced LIDAR applications for habitat assessment. Completion of these projects will reduce potential constraints on military training associated with the Indiana Bat Recovery Plan currently in revision and under Army review and a possible listing petition for the Gopher Tortoise. In FY09, will evolve research from reactive, single species research applications for currently listed species to a multi-species approach for improved detection of Species at Risk (SAR) and predictive synthesis models for effects of military disturbance on SAR. This will assist the Army in reducing the number of future listed species and their associated constraints on military training.	3809	3000	3115	2495
Predictive Risk Assessment and Management for Army Ranges and Training Lands: In FY06, completed integration of munitions carrying capacity model as a component platform consistent with the Installation Training and Maintenance (ITAM) Army Training and Testing Area Carrying Capacity (ATTACC) methodology. Environmental Impacts on Joint/Army Ranges: In FY06, conducted cost benefit analysis for land rehabilitation projects that improved erosion control practices and prioritization of sites for training land rehabilitation. Identified culturally influenced components for incorporation into Future Force urban ranges. Matured improved guidance on noise complaint risk associated with training noise levels. In FY07, complete initial groundwork for studies on impacts of discrete noise on ranges to meet new regulatory requirements and mature ATTACC protocols that incorporate non-military land and natural resource stressors. In FY08, will begin developing and evaluating strategies to mitigate high priority invasive species impact on training, and the cumulative interaction of training activities and multiple use on natural resources. In FY09, will complete initial algorithms for	3170	3931	2702	2302

weather and nonlinear effects on sound propogation and initial stimulus and response metrics and procedures for determining discrete noise impacts.				
Small Business Innovative Research/Small Business Technology Transfer Programs		56		
Total	6979	6987	5817	4797

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602782A - Command, Control, Communications Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	45044	48412	22215	24046	24521	25056	25607	26171
779	C2 & PLAT ELEC TECH	7710	8483	7926	9543	9864	10287	10513	10745
H92	COMMUNICATIONS TECH	10258	12337	14289	14503	14657	14769	15094	15426
TR9	C3 COMPONENT TECHNOLOGY (CA)	27076	27592						

A. Mission Description and Budget Item Justification: This program element (PE) researches advanced communications technologies and expands scientific knowledge of Command and Control (C2), and electronics systems/subsystems for use in the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The intent is to provide the Army with enhanced capabilities for secure, mobile, networked communications, assured information delivery, and presentation of information that enables decision-making. This will be achieved by improving the command, control, and communication systems (e.g. man-machine interfaces, information management, data analysis, mobility, security, capacity, safety, reliability, and survivability) for both air and ground platforms, including the dismounted Soldier. Commercial technologies are continuously investigated and leveraged where possible. Project 779, C2 and Platform Electronic Technology, funds applied research on infrastructures and technologies that enable management of information across the tactical and strategic battle space, provide automated cognitive reasoning and decision making, and allow timely distribution, display, and use of C2 data on Army platforms. This applied research also includes enhancements to the Global Positioning System (GPS) user equipment to provide more robust, anti-jam position and navigation capabilities, and improvements to man-machine interfaces and decision aids for increased operational tempo in an On-the-Move (OTM), network-centric battlefield environment. Project H92, Communications Technology, funds research that will provide technologies that allow Current and Future Force field commanders to communicate OTM to/from virtually any location, in a seamless, secure, self-organizing, self-healing, network. Integrated networks of unmanned remote sensors, maneuver and fire support elements, and situational awareness (SA) tools will allow the Future Force to achieve overmatch with agility and versatility. In addition, portions of the research support the Joint Tactical Radio System (JTRS) evolutions. Project TR9 funds congressional special interest efforts.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this program element (PE) contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0603008A (Electronic Warfare Advanced Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology). Work in this PE is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602782A - Command, Control, Communications Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	49242	21193	23488	24089
Current BES/President's Budget (FY 2008/2009)	45044	48412	22215	24046
Total Adjustments	-4198	27219	-1273	-43
Congressional Program Reductions		-325		
Congressional Rescissions				
Congressional Increases		27900		
Reprogrammings	-4198	-356		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1273	-43

Sixteen FY07 congressional adds totaling $26742 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($3835) Enh Wireless Digital Com f/Urban First Responders
($1055) Portable Flexible Communication Display Device
($1870) Digital Alert Display for Army Commanders
($1582) Highly Mobile Large-Scale C4ISR Cmd Post Sys
($3067) Improved Bandwidth for Battle Communications
($958) Integrated Lightweight Electronics Shelter
($3451) Lightweight Inter-Theater Transportable TOC
($958) Ultra Wideband Chip Set
($958) USB Data Acquisition for Voice Recognition/Respons
($958) C4ISR Integ Digital Env Service Model (IDESM)
($958) Dynamically Managed Data Dissemination (DMDD)
($958) Innovative Wireless Technologies
($958) Lightweight 10-meter Antenna Mast
($958) Nanophotonic Device Development
($2684) Ruggedized Cylinders f/Expandable Mobile Shelters
($1534) Tac B-width Booster for Mobile Net-Centric Warfare

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602782A - Command, Control, Communications Technology**	**779**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
779 C2 & PLAT ELEC TECH	7710	8483	7926	9543	9864	10287	10513	10745

A. Mission Description and Budget Item Justification: This project researches and applies new concepts and techniques in Command and Control (C2) to achieve enhanced military capabilities for the Future Force, and where applicable for the Current Force. The Future Force will require leaders at all levels to have continuous and accurate situational awareness to make informed and rapid critical decisions to "shoot, move, and communicate" more quickly than the adversaries. This project performs the applied research that will enable commanders at all echelons to have better and more timely information and will allow them to command from anywhere on the battlefield. Emphasis is on two critical cornerstones of Battle Command; data management and automated analysis, to provide course of action determination, mission planning and rehearsal, mission execution monitoring and replanning, and precision positioning and navigation. New enabling technologies that support the current thrusts also are explored, such as multi-modal man-machine interactive technology, battle space visualization, automated cognitive decision aids, real-time collaborative tactical planning tools, data transfer, distributed data bases, advanced open system architectures, and integration concepts which contribute to more mobile operations. The Battle Space Awareness and Positioning program investigates positioning, navigation, and tracking sensor/integration technologies to provide position, velocity, and time information to support operational and training requirements, especially in hostile electro-magnetic interference and other Radio Frequency (RF) degraded environments. The C2 OTM enabling technologies effort designs and develops technologies and decision aids that enable course of action (COA) generation and analysis that enables C2 OTM. The Networked Enabled Battle Command effort investigates and evaluates information search, retrieval, and decision models to enable seamless interoperability between tactical battle command and echelons above brigade.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Battle Space Awareness and Positioning: In FY06, completed initial integration of Global Positioning System (GPS) with three prototype auxiliary navigation technologies: RF ranging, enhanced dead reckoning, and Micro Electro Mechanical System (MEMS) Inertial Measurement Units (IMUs) into a complete positioning, navigation, and tracking system for dismounted Soldiers in complex and urban terrain; prepared and conducted field test assessments of the integrated dismounted urban position/navigation technology to show its capability to provide enhanced situational awareness even when GPS is unavailable; continued the investigation of performance improvements for MEMS IMUs for dismounted Soldier and tactical vehicle applications. In FY07, develop improvements for MEMS navigation sensors for dismounted Soldier and tactical vehicle applications and evaluate human (loco)motion modeling compensation for dismounted Soldier operations in urban areas. In FY08, will investigate advanced positioning/navigation sensor technologies and will conduct trade studies to determine applicability of advanced network algorithms and processes within the context of emerging brigade combat team (BCT) architectures; will continue the investigation of performance improvements in order to improve the accuracy in MEMS IMUs for dismounted Soldier and tactical vehicle applications. In FY09, will downselect the sensor suite and will demonstrate advanced positioning/navigation sensor integration techniques with advanced network algorithms and processes compatible with BCT architectures to enable robust position information for enhanced situation awareness in GPS denied, urban, and other complex	3202	1932	2933	2000

environments. Work on this effort is also being accomplished under PE/Project: 0603772A/101.				
C2 OTM Enabling Technologies: In FY06, planned and designed the architecture of an intelligent agent software toolkit that will generate Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) software agents that can interoperate with each other on a common framework. In FY07, construct the intelligent agent software toolkit and develop an intelligent agent testbed to integrate, test, and validate all software agents used in C4ISR. In FY08, will partner with the Space and Missile Defense Command (SMDC), Space Technology division on an effort to develop intelligent software agents that operates in both space and strategic (e.g. Missile Defense) as well as terrestrial domains; will design, develop, and transition software agents that can be user defined and interoperable in the operational environments for battle command, intelligence, surveillance, and reconnaissance (ISR), and logistic customers. In FY09, will continue to work with SMDC to further the development of intelligent software agent services with the addition of automatic discovery which enables agents to reduce the need for user intervention by automatically searching and retrieving data from other agent services; will apply automatic discovery intelligent software agent technology to help optimize data initialization and information management in all domains and transition intelligent agent services to PEO C3T will evaluate machine language translation tools and parsing techniques for the purpose of text-to-text and speech-to-speech translation in order to provide enhanced collaboration among joint coalition forces.	676	2100	4993	7543
Network Enabled Battle Command: In FY06, designed and developed software technology capable of intelligently regulating/prioritizing flow of information between low bandwidth and higher bandwidth networks based on understanding of network status and battle context, evaluated software to assure net-centric information flow across echelons was optimized; investigated knowledge acquisition and representation technology to capture experienced/expert commander's battle decision, as a function of situation and mission, in a form that computers can read and process. In FY07, investigate advanced effects based decision models that automatically match emerging patterns in the common operating picture and the mission to those in the knowledge base of recommended decisions for a given situation; develop automated wargaming tools that allow commanders to project potential effects of decisions and assess sensitivity of alternate options on future battle state; design a running estimate process for the Joint Tactical Common Operating Picture Workstation that compares a plan with actual situational awareness data and recommends adjustments to the plan. Work on this effort is also being accomplished under PE/Project: 0603772A/101.	3832	4396		
Small Business Innovative Research/Small Business Technology Transfer Programs		55		
Total	7710	8483	7926	9543

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602782A - Command, Control, Communications Technology**	**H92**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H92 COMMUNICATIONS TECH	10258	12337	14289	14503	14657	14769	15094	15426

A. Mission Description and Budget Item Justification: This project researches and applies advanced communications and network technologies to meet the network-centric battlefield needs of the Future Force, including the dismounted Soldier. The strategy is based on leveraging and adapting commercial technology to the maximum extent possible and focusing research efforts on those areas not addressed elsewhere (e.g. mobile radio based infrastructures, security in narrowband environments, multiband On-the-Move (OTM) transmit, and receive antennas, adaptive protocols, and low probability of interception/low probability of detection). The Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) effort develops software tools that enable the Warfighter to dynamically plan, predict, and visualize network communications performance due to maneuver and environmental effects faster than real time and proven through modeling and simulation. Modeling and Simulation (M&S) for Network Design effort will design and mature a software tool to conduct computer aided design, assessment and analysis of, multi-tiered, mobile-wireless ad hoc network designs, alternative designs, and design options for large military networks. The programmable encryption technologies effort will design and develop solutions to address emerging requirements for Joint Forces secure and dynamic high speed communications cryptography requirements. Radio Enabling Technologies and Nextgen Applications (RETNA) designs and develops affordable radio components and enabling technologies to improve Joint Tactical Radio System (JTRS) range, throughput, and reliability performance. The Antenna Technologies effort investigates low cost, low profile omni directional, and directional antennas and antenna components for line-of-sight (LOS) and OTM satellite communications (SATCOM). Tactical Wireless Network Assurance (TWNA) funds research in network protection and wireless intrusion detection technologies for mobile wireless ad hoc networks and provides safeguards against modern network attacks.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Communications Planner for Operational and Simulation Effects with Realism (COMPOSER): COMPOSER consists of the following software modules: Communication Effects Simulator (CES), Network Visualizer (NV), Spectrum Manager, and Architecture Framework. In FY06, conducted laboratory testing of COMPOSER technology and evaluated technology in the Training and Doctrine Command (TRADOC) Battle Lab Collaborative Simulation Environment (BLCSE); enhanced the CES which provides communications realism by calculating the performance of each communication link faster than real time for planning purposes and man in the loop experimentation and visualization capability; developed spectrum manager capability resulting in a beta version of COMPOSER. In FY07, perform analysis of available radio models and waveforms and integrate the waveforms to test interoperability with COMPOSER tools; mature spectrum management capability, improve the speed and accuracy of the CES. In FY08, will complete enhancements to CES; will increase the integration of waveform models to CES; will complete spectrum management capability; will develop final version of COMPOSER for transition to the Coalition Joint Spectrum Management Planning Tool Joint Concept Technology Demonstrations. Work on this effort is also being accomplished under PE/Project 0603008A/TR1.	2789	1544	300	
Radio Enabling Technologies and Nextgen Applications (RETNA): In FY06, designed the Handheld Manpack Small Form Fit (HMS)	3046	1699	1844	

Joint Tactical Radio Systems (JTRS) Manpack Power Amplifier (PA) subsystems; planned, developed, and tested breadboard layouts of complex RF filter banks, diplexer systems, low-loss power conditioner modules, interface, and control electronics, and core wideband power amplification (WBPA) subsystems; developed a system-level WBPA breadboard by simulating then physically placing validated subsystems onto breadboard prototype. In FY07, develop HMS JTRS Manpack PA form-fit brassboard; validate the PAs component performance and associated system-level capability; identify root causes of waveform porting difficulties through failure and risk analyses to software defined radio (SDR). In FY08, will perform detailed investigation and experimentation into the development of HW/SW and porting of waveforms onto JTRS representative SDR platforms; will develop capability to reduce the complexity of porting software waveforms onto SDR hardware.				
Antenna Technologies: In FY06, developed a Ku band baseline antenna; developed methods of integrating radio frequency (RF) electronics into SATCOM antenna assemblies; initiated development of low cost transmit/receive, X-band OTM antenna systems. In FY07, conduct modeling and simulation to validate terrestrial directional antenna (TDA) parameters/link connectivity; develop innovative methods for integrating radio frequency (RF) electronics into X-band antenna assembly; develop methods of integrating Ku and Ka band transmit/receive into one OTM ground antenna system; develop methods of integrating power amplifiers into antenna assemblies; and investigate various low profile antenna technologies. In FY08, will complete development of TDA technologies for mobile ground platforms providing air interface for terrestrial directional networking and beam steering protocols; will investigate hybrid scan and phased array antenna technologies for a low profile multi-beam OTM SATCOM antenna for use with military Ka band and commercial Ku band satellites. In FY09, will develop multi-beam low profile OTM SATCOM antenna in a single frequency band (Military Ka or Commercial Ku); will investigate adding the second SATCOM frequency band; will develop tri-band low profile (Ka, Ku, Q Band) OTM SATCOM vehicle antenna.	2344	2907	4651	6903
Programmable Objective Encryption Technologies (POET): POET is a jointly funded effort with US Navy, Air Force, Marine Corps, to develop high speed, 4-channel, remotely programmable, embeddable crypto device. In FY06, solidified new cryptological embedded chip design requirements and developed initial design. In FY07, develop and deliver emulator version of the cryptological embedded chip design to the High Capacity Communications Capability (HC3), the Navy Multiband Terminal (NMT), and the Air Forces Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) program offices; provide testbed verification of the performance specifications of the emulator; perform a critical design review to determine the merits of continuing development effort into the next phase. In FY08, will develop Engineering Development Model (EDM) and deliver Non-Certified EDMs for start of Government Lab Evaluation/Test with a simulated host terminal; will perform initial NSA Certification testing and implement design changes based on test results. In FY09, will conduct a Lab Evaluation and certification, effort will complete with a Certified EDM delivery.	557	815	1500	1500
M&S for Network Designs: In FY06, performed assessment and initiated development to address the challenges of connectivity, maintaining desired capacity, and ensure survivability in large-scale mobile ad hoc networks; investigated application and demonstration of initial prototype code for preliminary robust optimization to network design, and design scenario. In FY07, baseline the network design capability to validate principles and rules that govern the behavior and performance of complex communication networks; assess and characterize the behavior and performance of the network (higher physical, data link and network layers) through analytical and M&S processes and technologies. In FY08, will evaluate the network design capability on a surrogate future force network; will interface network design algorithms with simulation; will characterize detailed end-to-end user performance metrics; will assess effectiveness of new networking technologies. In FY09, will extend the ad hoc network design tool to include modeling and representation of the C4ISR nodal functionalities; will develop a comprehensive representation of the internal operation and performance of network data dissemination mechanisms; will improve the network traffic characterization model.	1522	2663	2700	3500
Tactical Wireless Network Assurance (TWNA) / wireless information assurance (IA): In FY06, provided intrusion detection algorithms		2552	3294	2600

for Future Combat System brigade combat team; evaluated database access control and authentication of mobile data elements that restrict unauthorized modification to mobile code by preventing unauthorized access on a 20 mobile node ad hoc network; tested adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time. In FY07, develop advanced IA techniques; expand wireless intrusion detection to detect attacks against mobile hosts and networks. In FY08, will investigate a suite of IA technologies to enable enhanced tactical battlefield information sharing across all security domains to meet emerging threats; these include cross domain boundary services with trusted labeling and data sanitization to enforce data release to lower classified domains and smart pull information requests from higher domains, software partitioning with controlled interface filtering to enforce push/pull of information across security domains, and malicious code detection that uses proactive, automated techniques to find vulnerabilities and software flaws via source code analysis and reverse engineering. In FY09, will investigate and develop jam resistant and low signal detection communication technologies including space-time adaptive techniques, cross layer algorithms, cognitive disruptive tolerant networking, and signal processing techniques; will develop IA technologies enabling information exchange across security domains, ensuring robust survivability of tactical networks and critical information against info warfare attacks.				
Small Business Innovative Research/Small Business Technology Transfer Programs		157		
Total	10258	12337	14289	14503

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602783A - COMPUTER AND SOFTWARE TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	4447	6719	5368	5510	5601	5697	5847	6024
Y10	COMPUTER/INFO SCI TECH	3488	3801	5368	5510	5601	5697	5847	6024
Y11	COMPUTER & INFORMATION SCIENCE APPLIED RES CA	959	2918						

A. Mission Description and Budget Item Justification: This program element (PE) funds research and application of information and communications technology to enhance the understanding and speed the decision cycle for mounted and dismounted commanders and leaders operating in the mobile dispersed environment envisioned for the Future Force. Focus is on a spectrum of command and control (C2) solutions for lower echelon teams. This program investigates and matures command, control, communications and computer (C4) technologies to increase Future Force lethality and survivability through improved commanders' decision making and situational awareness and, where feasible, exploits opportunities to enhance Current Force capabilities. The goals of this program element are to develop information processing technologies to automate the delivery of local/global information for decision making (planning, rehearsal, and execution) so that it is synchronized, parallel, real-time, and to devise communication/network technologies that will enable the synchronization of secure data/information from humans to humans, humans to computers, computers to humans, as well as reducing dependence on mouse and keyboard versus other modes of computer interaction. Challenges for this program include developing automated tools to support the discovery of services within an unreliable ever-changing network topology as well as providing methods for end-users to understand the tactical significance of events generated from both local and global tactical sensors. Technologies addressed in this work will enable a spatial and temporal explanation of the situation through graphical and narrative based multi-media reporting for the commander. Work in this PE is related to and fully coordinated with efforts in PE 0602782A(Command, Control, Communications Technology), PE 0603772A(Advanced Tactical Computer Science and Sensor Technology), and PE 0603008A(Command, Control, Communications Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL). Project Y11 contains congressional adds only.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602783A - COMPUTER AND SOFTWARE TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	4521	3844	3785	3810
Current BES/President's Budget (FY 2008/2009)	4447	6719	5368	5510
Total Adjustments	-74	2875	1583	1700
Congressional Program Reductions		-26		
Congressional Rescissions				
Congressional Increases		2950		
Reprogrammings	-74	-49		
SBIR/STTR Transfer				
Adjustments to Budget Years			1583	1700

In FY08 and FY09 funds increased to explore statistical based tools for design and anlysis of complex networks to support development of network-centric operations.

Two FY07 congressional adds totaling $2828 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($959) Biologically-Inspired Security Infrastructure
($1869) Commercial O-T-Shelf Military (COTS-M) Scout Robot

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602783A - COMPUTER AND SOFTWARE TECHNOLOGY**	**Y10**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Y10 COMPUTER/INFO SCI TECH	3488	3801	5368	5510	5601	5697	5847	6024

A. Mission Description and Budget Item Justification: This project funds research and application of information and communications technology to enhance the understanding and accelerate the decision cycle time for mounted and dismounted commanders and leaders operating in the mobile dispersed environment envisioned for the Future Force. Focus is on a spectrum of command and control (C2) solutions for lower echelon teams. Research within this project investigates and matures command, control, communications, and computer (C4) technologies to increase Future Force lethality and survivability through improved commanders' decision-making and situational awareness and, where feasible, exploits opportunities to enhance Current Force capabilities. The goals of this project are to develop information processing technologies to automate the delivery of local/global information for decision making (planning, rehearsal, and execution) so that it is synchronized, parallel, real-time and to devise communication/network technologies that will enable the synchronization of secure data/information from humans to humans, humans to computers, computers to humans, as well as reducing dependence on mouse and keyboard versus other modes of computer interaction. Challenges for this program include developing automated tools to support the discovery of services within an unreliable ever-changing network topology as well as providing methods for end-users to understand the tactical significance of events generated from both local and global tactical sensors. Technologies addressed in this work will enable a spatial and temporal explanation of the situation through graphical and narrative based multi-media reporting for the commander. Work in this project is related to and fully coordinated with efforts in PE 0602782A (Command, Control, Communications Technology), PE 0603772A (Advanced Tactical Computer Science and Sensor Technology), and PE 0603008A (Command, Control, Communications Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Enhance information processing techniques through the interactive and automated fusion of distributed local and global information sources in order to inform and protect the force from imminent threats. User directed fusion techniques that combined with the Communications-Electronics Research, Development, and Engineering Center's (CERDEC) techniques will enable semi-automated fusion techniques to improve the completeness and timeliness of decision-making in C2 operations. The integrated technology will be matured for Distributed Common Ground Station-Army (DCGS-A) and Future Force assessment. In FY06, investigated Resource Description Framework (RDF) and Ontology Web Language (OWL) for marking up current Command and Control Information Exchange Data Model and future data-stores to include discovering content through published meta-data. In FY07, mine marked-up RDF and OWL based data-stores for events/associations across disparate data sources. In FY08, will implement ontology to formalize the representation, attributes, and transforms necessary to track a soft target using various data sources. Will integrate soft target tracking algorithms as small, self-contained fusion services that support the Intelligence Analyst in interpreting battlefield events. In FY09, will transition fusion services to CERDEC for integration into DCGS-A.	1012	1100	1083	1090
Conduct applied research on tactical information protection technologies for agent-based vulnerability assessment over wireless bandwidth constrained links and security infrastructures for sensor networks. The Future Force will operate in a complex wireless environment where survivability must be maintained in spite of inherent vulnerabilities of standardized protocols and commercial technologies. In FY06, validated advanced network assurance techniques using 20 network nodes in a tactically representative	965	961	1033	1040

environment. In FY07, implement and evaluate cooperative algorithms for detecting sophisticated attacks involving multiple colluding nodes against Mobile Ad Hoc Network (MANET) routing protocols. Evaluate clustering algorithms for creating and maintaining a dynamic hierarchy of cooperative intrusion detection components in MANETs. Implement a prototype network protocol that increases current efficiency of media-access control. In FY08, will investigate and evaluate an integrated distributed wireless intrusion detection system (IDS) capable of detecting multiple classes of intrusions from multiple simultaneous intruders. Enhance network protocol to provide a more efficient healing process. In FY09, will evaluate the scalability of the distributed wireless IDS system in large networks and determine the expected bounds of performance (e.g. overhead, missed detection probability, and false alarm probability).				
Investigate techniques to enable automated integration of global and local information, allowing tactical assets to cooperatively share sensed events within a wireless distributed fusion environment in order to inform the force of relevant events. In FY06, investigated the correlation and tracking agents that provide end-user directed mining of spatially/temporally linked objects. In FY07, using a Distributed Interactive Semi Automated Forces (DISAF) simulation, evaluate the ability of the distributed agent infrastructure to provide a tactically relevant picture of the local operational environment through a series of time sequenced events. In FY08, using social networking concepts will develop soft target tracking algorithms that can be used to identify relevant changes in the tactical environment. In FY09, will integrate cross-security-level information exchange algorithms to insure tactically relevant information is presented to the user in a minimally intrusive manner.	1007	1146	1128	1135
Conduct research into techniques for developing the underlying computational multilingual software framework to enable commanders and troops to bridge language barriers in order to anticipate adversaries and collaborate with allies. In FY06, defined the underlying framework for document exploitation, indexing, and search across archived translated documents. Evaluated current state-of-the-art in two-way speech-to-speech translation technologies to include microphones that can operate in noisy environments. In FY07, enhance the underlying framework to include the ability to extract the metrics required for evaluation of text based machine translation engines. Develop the underlying software framework to integrate the best microphone and two-way speech technologies. In FY08, will implement optical character recognition (OCR), machine translation and name extraction via web services in Deployable Harmony DOCEX System (DHDS) and DCGS-A test beds. In FY09 will evaluate use of prototype document image processing tools operating through web service on noisy and handwritten foreign language documents.	504	549	541	545
Statistical based methods for studying networks supports theory development in network science. It will provide a basis to validate or invalidate theoretical results, point gaps between theory prediction, and field performance, provide experimental verification of mobility, channel, topology models, and of convergence of adaptive protocols, guide development of the theoretical effort by providing a basis for refining models and assumptions. All of this leads to the right levels of robust abstraction to understand network behavior. This will result in a tight coupling between theoretical developments, simulation, emulation, and over-the-air testing in lab and field environments. The long-term goal is to develop a real-time adaptive statistical analysis system that is coupled to a monitoring system that can infer/learn global network behavior and to a control system that controls local behavior so as to predictively improve performance, while ensuring the stability of the overall system. In FY08, will acquire software and hardware, including network monitoring tools, and setup emulation and in-the lab/field experiments to gather network performance data, based on algorithms developed in this PE/Project. In FY09, will refine and expand the scope of the effort (size of the network, complexity of the deployed algorithms and protocols, heterogeneity of the nodes, harshness of the RF channel conditions and sophistication of the adaptation). Theoretical work will be validated against the acquired data.			1583	1700
Small Business Innovative Research/Small Business Technology Transfer Programs		45		
Total	3488	3801	5368	5510

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	48789	51278	51120	52118	52903	53563	55026	56441
855	TOPOGRAPHICAL, IMAGE INTEL & SPACE	11634	11318	14719	15438	16066	16748	17668	18559
H71	ATMOSPHERIC INVESTIG	6472	6741	6676	6853	6927	6980	7134	7290
T40	MOB/WPNS EFF TECH	16136	15560	17565	17747	17942	18087	18485	18892
T41	MIL FACILITIES ENG TEC	4834	5034	4206	4085	3976	3778	3722	3617
T42	COLD REGIONS ENGR TECH	4334	4550	4680	4761	4812	4850	4957	5046
T45	ENERGY TEC APL MIL FAC	2790	3377	3274	3234	3180	3120	3060	3037
T48	Center for Geosciences & Atmospheric Research	1630							
T52	Stationary Power and Energy Applied Research (CA)		3857						
T53	Military Engineering Applied Research (CA)	959	841						

A. Mission Description and Budget Item Justification: The objective of this applied research program element (PE) is to provide military engineering technologies in support of the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Research is conducted that supports special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Results are tailored to support the materiel development, test, and operations communities in evaluating the impacts of weather, terrain, and atmospheric obscurants on military materiel and operations. Major research efforts focus on: advanced distributed simulation including networking of models, complex data interchange, and collaborative training; military engineering including improving airfields and pavements, sustainment and cold regions engineering, vehicle mobility modeling, and reduced logistics footprint at base camps; facilities engineering including simulation of infrastructure capabilities for force projection, protection, and readiness; and battlespace environments including terrain awareness. This research improves the efficiency and cost effectiveness of supporting the training/readiness/force projection missions in garrison and force sustainment missions in theaters of operation. Research is transitioned to PE 0603734A (Military Engineering Advanced Technology), PE 0603125A (Combating Terrorism, Technology Development), and to Project Managers (PM) such as PM Force Projection and Project Director, Combat Terrain Information Systems. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, and the Army Research Laboratory located at Aberdeen, MD, execute the project work.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	50318	50098	50302	50811
Current BES/President's Budget (FY 2008/2009)	48789	51278	51120	52118
Total Adjustments	-1529	1180	818	1307
Congressional Program Reductions		-3196		
Congressional Rescissions				
Congressional Increases		4750		
Reprogrammings	-1529	-374		
SBIR/STTR Transfer				
Adjustments to Budget Years			818	1307

Three FY07 congressional adds totaling $4552 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($2779) Army Power and Energy Initiative
($958) National Fuel Cell Research for Military Application
($815) Airborne Threats

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**	**855**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
855	TOPOGRAPHICAL, IMAGE INTEL & SPACE	11634	11318	14719	15438	16066	16748	17668	18559

A. Mission Description and Budget Item Justification: The objective of this applied research project is to provide advanced technologies for storing, transforming, updating, and disseminating extremely large volumes of terrain and weather effects data at, or near, real-time and dynamic analysis and reasoning of this data to enable Future Force Command and Control Systems with superior knowledge of the battlespace terrain and environment. Work in this project significantly enhances the Army's geospatial data management and dissemination capabilities. Weather and atmospheric data is provided for this project through the Army Research Laboratory efforts funded in program elements (PE) 0601102A Project 52C and PE 0602784A Project H71. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Data Generation: In FY06, matured capabilities to geo-encode non-spatial sources to support planning and military decision-making process. In FY07, develop and refine technologies to detect and geo-locate chemical and biological agents and begin incoporating this capability into sensor technology that can be deployed in the battlespace environment. In FY08, will experiment with prototype sensors and develop methodologies to integrate the data collected into a geo-database. In FY09, will design and develop new capabilities that exploit sensor data from various sources (including Soldiers, imagery, and lidar) to rapidly generate minimum required geospatial data needed to support operations in various terrain (e.g., urban and complex terrain).	1898	1783	2488	2615
Data Management: In FY06, completed development and testing of imagery, elevation, and feature data integration methods and tools for transition to Army systems/services. In FY07, develop and test a geospatial data model that incorporates traditional terrain data types and also includes detailed tactical HUMINT data. In FY08, will develop and refine tools to correlate and fuse geospatial data from various sources (including tactical sensors and other sources) into a common geospatial database that supports multiple applications. In FY09, will implement new geospatial terrain and cultural data technologies, taxonomies and models to ensure interoperability and sharing of information.	4912	4455	5798	6076
Data Analysis: In FY06, refined and evaluated prototype, stand-alone situation and threat analysis tools. In FY07, mature urban terrain reasoning tools that incorporate the effects of natural, man-made features, and human activities into urban course of action planning tools. In FY08, will develop a state of the art model for evidential reasoning that incorporates terrain and cultural conditions. In FY09, will complete experimentation and protyping to include connection to Future Combat Systems brigade combat team. Will evolve standalone evidential reasoning model(s) from standalone to reachback services.	4824	4949	6433	6747
Small Business Innovative Research/Small Business Technology Transfer Programs		131		
Total	11634	11318	14719	15438

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**	**H71**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H71 ATMOSPHERIC INVESTIG	6472	6741	6676	6853	6927	6980	7134	7290

A. Mission Description and Budget Item Justification: The objective of this project is to perform applied research for tactical weather and atmospheric effects algorithms, and for the integration of battlefield atmospheric environments simulations. The Army's transformation plan to the Future Force will require capabilities for battlefield commanders to make decisions based on tactical weather technology and impacts. This weather intelligence data will have to be not only accurate and timely, but distributed down to the lowest levels of command, which may include the individual Soldier. This project accomplishes this mission by transitioning technology to the Program Manager, Distributed Common Ground Station-Army (DCGS-A) through the Integrated Meteorological System (IMETS), through support to the Project Manager for Target Identification and Meteorological Systems (PM-TIMS) for field artillery systems, and to the Department of Defense (DoD) modeling community. It provides detailed model applications for various effects of the atmosphere on electro-optical and acoustic target detection, location, and identification. This project devises both physics-based decision aids and rule-based expert systems for assessing the impacts of weather on a very broad spectrum of friendly and threat weapons systems, sensors, platforms, and operations. These can be applied for mission planning, battlefield visualization, optimum weather sensor, and Reconnaissance Surveillance Target Acquisition (RSTA) sensor placement; route planning to maximize stealth and efficiency, tactical decision aids, and modeling and simulation of weather impacts for combat simulations and war games. This project supports the Army's transformation to the Future Force through future applications and platforms that support echelons at Brigade and below, down to the individual Soldier, and Defense Technology Objectives, Weather/Atmospheric Impacts on Sensor Systems, and On-Scene Weather Sensing and Prediction Capability. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Mature a new high resolution, short-range forecasting capability based on integrating new battlefield meteorological data sources (non-conventional meteorological sensors such as Unmanned Aircraft Systems (UAS), robotic sensors, etc.) into model initialization which will directly impact nowcast (very short-range forecast) accuracy over target areas and provide much higher resolutions over the theater of operations. Adapt and apply a research version of an operational forecast/meteorological model that can ingest data from meteorological satellites, UAS, and ground-based sensors. Research and verify the capability to host the model on battlefield processors, including battlefield fire support systems, to autonomously generate artillery meteorological messages and produce near real time decision aids. In FY06, delivered an initial Weather Running Estimate capable of ingesting conventional sources data for real-time updates of databases and forecast predictions supporting DCGS-A weather services during mission execution. In FY07, design and evaluate a Local Analysis and Prediction System (LAPS) capable of ingesting data from conventional and non-traditional data sources for nowcasting applications. In FY08, will integrate a complete Weather Running Estimate-Nowcast (WRE-N) capability for DCGS-A that will support the fidelity and timeliness of the forecasts. Will evaluate the use of Weather Research and Forecasting (WRF) model as part of the LAPS package within the WRE-N system for improved ability to ingest data from both conventional and non-traditional sources. In FY09, will formulate new methods to use microscale model output for critical micro-UAS flight parameters that can improve the launch, operation, and recovery of UAS assets. Research, design, and apply high resolution meteorological model improvements that account for fine scale structure in the urban boundary layer meteorology for an improved capability for predicting atmospheric effects.	2356	2539	2573	2608

Investigate critical value thresholds for weather impacts on friendly & threat systems for the rule-based Integrated Weather Effects Decision Aids & develop physics-based atmospheric effects models for operational combat mission planning, simulations, and sensor/weapon development. Mature the Sensor Performance Evaluator for Battlefield Environments (SPEBE) and tri-service Target Area Weapons Software as key acoustic and electro-optic decision aids. Integrate distributed client applications on mobile devices for "first in" decision aids and for "over watch" of lower echelons. Devise access to weather on embedded Soldier and system processors. Integrate vegetation and terrain effects and infrasonic frequencies into SPEBE to support intelligence analysis. In FY06, integrated an acoustic and seismic decision aid into a library of analysis modules tailored for user applications for better understanding of the effects of sound on military requirements for sense and avoid. In FY07, integrate UAS route planning decision aids based on effects of winds, terrain, and weather hazards on platform and sensor performance. Design UAS mission route flight optimization capability including enroute adjustments to account for atmospheric conditions. Adapt neural network acoustic propagation model into SPEBE to achieve a faster solution. In FY08, will employ automated Weather Intelligence-Routing (WIN-R) UAS flight optimization capability enabling automated route adjustments based on detected atmospheric effects. In FY09, will construct an acoustic model predicting the effects of single urban structures on detection and avoidance capabilities. Will explore machine-to-machine capability options for autonomous UAS flight control using WIN-R technology that will eliminate the need for the man-in-the-loop. Will integrate wideband enhancements to Tri-Service MODTRAN. Will integrate night-time illumination model improvements into Tri-Service Target Acquisition Weapons Software (TAWS)	2072	2081	2105	2141
Integrate high resolution boundary layer meteorological (met) measurements with models to improve condition prediction in urban/complex terrains. Enable continuous assimilation of real time, 3D Light Detection And Ranging (LIDAR) remotely sensed wind data into micro-scale urban complex terrain wind models for near real time, 3D picture of the atmosphere. Achieve 25:1 or greater compression of 2D, 3D, and 4D met databases. Devise/verify algorithms for optimum met sensor placement. Perform detailed measurements of the urban met environment for modeling use. In FY06 measured, characterized and analyzed meteorological data over urban/complex terrain that increase understanding of atmospheric phenomena and effects. Investigated automation techniques for optical signature sorting of aerosol particles to more quickly identify threat agents. In FY07, investigate the use of super-continuum LIDAR for remote spectral identification of chemical/biological threat agents. Will explore the potential of using parameterized slope flow effects in a microscale wind model for greater fidelity and accuracy. Will evaluate urban wind field models through field experiments for optimum met sensor placement. In FY08, will prepare a microscale wind model for urban domains initialized with WRE-N and WRF model output with computationally efficient data assimilation methods. Will investigate the capture efficiency of single particle aerosol extraction technologies and explore urban field measurement data against urban wind flow predictive models. In FY09, will employ stable boundary layer to improve existing high resolution boundary layer meteorological models. Will simulate and evaluate use of a microscale wind model as an integrated part of the DCGS-A weather system. Will develop and integrate a Doppler LIDAR Analysis Toolkit (DLAT) for semi-autonomous data assimilation and processing. Will investigate an integrated aerosol separation and bioassay instrument for detecting bio-aerosols.	2044	2101	1998	2104
Small Business Innovative Research/Small Business Technology Transfer Programs		20		
Total	6472	6741	6676	6853

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**	**T40**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T40 MOB/WPNS EFF TECH	16136	15560	17565	17747	17942	18087	18485	18892

A. Mission Description and Budget Item Justification: The objective of this applied research project is to provide technologies for rapid upgrading, construction, and repair of in-theater airfields; for overcoming battlespace gaps through prediction, definition, avoidance, or defeat; for expedient force protection during contingency operations; for rapid port enhancement. This research supports development of the Future Force by providing physics-based representations of mobility, obstacle, and barrier placement, survivability, and weapons effects in urban terrain modeling and simulation. Additionally, the project matures technologies that increase the survivability of critical assets from conventional and terrorist weapons, and maneuver support of deployed forces, while reducing their logistical footprint. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Force Protection: In FY06, developed, tested, and delivered algorithms to the Anti Terrorism Planner software (200 plus registered users) and the J34's Joint Antiterrorism/Force Protection Portal for assessing the effectiveness of blast/fragment protection upgrades to structures in contingency environments that increased the resistance of structures by 90 percent to 200 percent above current minimal protection. In FY07, develop algorithms for survivability design and assessment tools; produce low-cost, threat specific modular protective systems for large areas at about 1/5th the cost per square foot of advanced composite and ceramic armors; initiate effort to develop technologies to provide protective materials and configurations against large caliber rockets and mortars, light artillery, and 50-caliber arms; and initiate effort to gain improved understanding of geophysical phenomenology to support detecting buried targets. In FY08, will create novel layered protective materials to defeat 50-caliber arms and develop procedures for numerical evaluation of protective materials through multi-scale modeling. Produce Automated Target Recognition (ATR) for tunnel and tunneling activity detection for use by Joint Task Force - North in their interdiction mission. In FY09, will provide protective systems and retrofits to defeat large caliber rockets, light artillery, and 50-caliber arms. Develop sensor/geophysical algorithms for disturbed material signatures to be utilized by sensors that detect buried objects. Initiate effort to provide expedient protection against artillery and small missiles relying heavily on the Computational Protection Testbed.	5033	6809	6456	6987
Enable Theater Access/Joint Rapid Airfield Construction: In FY06, selected and tested rapid repair materials for paved airfield surfaces. In FY07, select and test shear-resistant stabilizers and dust control additives for semi-prepared C-17 airfield surfaces. Rapid Port Enhancement In FY06, finalized design of Lightweight Modular Causeway System (LMCS) and completed the Small Port Throughput Simulation Model and supported Joint Enable Theater Access initiatives. In FY07, support Joint Enable Theater Access-Sea Ports of Debarkation Advanced Concept Technology Demonstration (ACTD) in conducting full-scale LMCS component testing and demonstration. In FY08, will provide technical designs and drawings to enable final fabrication and/or modifications as necessary to the ACTD system that will be tested in a controlled field environment, including two full-scale LMCS sections and the JETA-SPOD Analysis Tool. ERDC engineers and scientists will monitor fabrication of the systems and provide Quality Assurance/Quality Control for the full-scale LMCS and will also provide design details and drawings for an Emplacement and Recovery System to be used on multiple launch platforms for the LMCS test series. In FY09, ERDC will support ACTD user evaluations by providing continued technical expertise,	4063	3767	6938	7865

guidance, and training to military units selected to test and evaluate the LMCS residuals. The residuals will include an Emplacement and Recovery System, two sections of LMCS (approximately 100 feet), and the associated mooring system. ERDC personnel will also prepare design modifications for the LMCS that arise from this series of tests and provide these design modifications to the Transition Manager. Initiate effort to develop the capability to rapidly identify and repair austere landing zones for vertical lift intra-theater access.				
Maneuver Support/Gap Defeat: In FY06, integrated reconnaissance technologies for characterizing critical features of terrain gaps less than 4 meters wide and conducted evaluations of gap crossing technologies in simulated environments; created a force response element that represents the soil/snow for any motion system operating in real time simulated environments. Hardened Combined Effects Penetrator Warheads In FY07, finalize algorithms to predict performance of ARDEC's Multi-Threat Objective Projectile (M-TOP) against urban targets. In FY08, will participate in M-TOP redesign using the ERDC-developed, DOD-accredited penetration model, PENCRV3D. Will participate in the M-TOP integrated demonstration by providing the instrumented structural target and weapons effects analysis. Future Force Breaching in MOUT. In FY09, will in cooperation with ARDEC, develop and transition a lightweight, single-stage explosive wall breaching system to Project Manager Close Combat Systems (PM-CCS) for SDD.	5223	2677	2483	1697
Geospatial Research and Engineering Support: In FY06, developed capability for transferring additional high-priority Battlespace Terrain Reasoning and Awareness (BTRA) maneuver-related information products to One SAF Objective System (OOS) and other applications, introduced extensions for computer-generated forces behaviors supporting training and course of action development and analysis. Determined feasibility of interpreting sensor data to characterize critical infrastructure. In FY07, produce and refine products/procedures for interoperability; expand scaling as required based on set of BTRA information products; incorporate additional behaviors and related components as necessary to support training and course of action development and analysis. In FY08, will create an Urban Tactical Decision Aid for planning the best mix of infantry and small unmanned ground vehicles for clearing a building. In FY09, will develop bridging analysis Tactical Decision Aid for determining necessary bridging assets to conduct gap crossing and defeat solutions and will support Geospatial Battle Management Language (GEOBML) syntax in support of the Battlespace Terrain Reasoning and Awareness - Battle Command (BTRA-BC) Army Technology Objective(ATO).	1817	2307	1688	1198
Total	16136	15560	17565	17747

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**	**T41**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T41 MIL FACILITIES ENG TEC	4834	5034	4206	4085	3976	3778	3722	3617

A. Mission Description and Budget Item Justification: The objective of this applied research project is to deliver sustainable, cost efficient, and effective facilities; and provide installation operations required to support the Future Force. The project focuses on advanced facilities and operations technologies directly supporting training, readiness, force projection, force protection, homeland security, and urban operations. Facility enhancement technologies contribute to cost reductions in the Army facility life cycle process (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal), and the supporting installation operations. This work improves the ability of installations to support forces to meet transformation goals, improves designs for close battle training facilities, and enhances security of Soldiers, families, and civilians. Technologies evolving from this work include integrated planning and design tools for CONUS facilities and forward bases, models predicting airborne dispersed chemical, biological, and radiological (CBR) effects on facilities and occupants; sustainable facility management; and collaborative decision support. In addition, technologies from this work will support analysis of cultural and facility issues in urban operations. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Facility Engineering: In FY06, established performance related requirements for building envelopes for airborne CBR protection. In FY07, complete protocols for determining boundary conditions (building exterior and interior) and boundary condition models for use by facility designers and operators to protect DoD facilities from air borne chemical and biological agents. In FY08, will develop and evaluate prototype Carbon Nanotube (CNT)-based filaments, membranes, and coatings that have 2-fold to 10-fold improvement in performance (strength, weight) over existing materials (e.g. steels, polymers) for installation infrastructure materials. In FY09, will develop and validate predictive models and algorithms for durability of fiber reinforced polymer (FRP) composites for facilities and equipment, based on mechanisms of deformation and degradation.	1849	1867	1537	1889
Facility Modeling and Simulation/Fort Future: In FY06 defined framework for incorporating facility use and cultural factors for tactical decision aids. Integrated modeling and simulation capability to rapidly assess and rehearse end-to-end deployments from multiple installations. In FY07, model buildings and cultural aspects of urban terrain in computationally efficient form. In FY08, will develop methods to enable units to rapidly understand local power relations and anticipate local responses for stability, security, transition, and reconstruction (SSTR) operations in heterogeneous communities. In FY09, will develop analysis and predictive capabilities to enable units to gain cultural competence relevant to their mission	2985	3167	2669	2196
Total	4834	5034	4206	4085

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**	**T42**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T42 COLD REGIONS ENGR TECH	4334	4550	4680	4761	4812	4850	4957	5046

A. Mission Description and Budget Item Justification: The objective of this applied research project is to provide warfighters with an accurate and timely understanding of the battlespace environment's effect on personnel, platforms, sensors, and systems in order to develop improved tactics, techniques, procedures, and plans that ensure information superiority, situational awareness, and force projection. Specifically, this project seeks solutions for minimizing or eliminating the adverse effects of dynamically changing terrain states on sensing capabilities, engineer construction, and tactical maneuver conducted by the Army. To achieve this, effective decision-making tools such as models, simulations, and mission planning and rehearsal factors are required that accurately predict the state of the ground, near-surface atmospheric conditions, and system performance in complex environments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Terrain State: In FY06, completed formulation for all-season, all-terrain, 3-dimensional soil modeling for input to ground platform and terrain mechanics simulations; completed model parameterization for vegetation and ground surface processes for tactical terrain analysis. In FY07, formulate new model of energy and mass exchange for exterior urban surfaces to support target surveillance and reconnaissance; validate models of radiant temperatures of urban exterior surfaces. In FY08, will establish and validate approaches such as real-time analysis techniques for sensor performance to greatly improve computational efficiency for carrying out terrain-state calculations. In FY09, will assess the use of risk-based analyses in employing terrain-sensitive platforms.	3280	3310	3001	3014
Signature Physics: In FY06, completed wide area infrared targeting template based on terrain-weather phenomena for wide range of targets and backgrounds. In FY07, formulate new approaches to multi-sensor fusion (e.g., acoustic and seismic) and optimization based on characteristics of a complex battlespace environment. In FY08, will design and evaluate tactical decision aids supporting multi-mode sensor missions with templates of geoenvironmental effects. Will develop algorithms to identify disturbed soil signatures based on sensor modality and geo-environment. In FY09, will design and evaluate sensor data fusion aids based on predicted environmental effects.	1054	1206	1679	1747
Small Business Innovative Research/Small Business Technology Transfer Programs		34		
Total	4334	4550	4680	4761

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602784A - MILITARY ENGINEERING TECHNOLOGY**	**T45**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T45 ENERGY TEC APL MIL FAC	2790	3377	3274	3234	3180	3120	3060	3037

A. Mission Description and Budget Item Justification: The objective of this applied research project is to provide technologies necessary for secure, energy efficient, sustainable military installations, emphasizing energy and utility systems protection from, and in response to, evolving threats such as chemical, biological, and radiological (CBR) attacks. Advanced energy technologies and processes are also applied to the Army's industrial base to maintain its cost-effective readiness for munitions production, training, and in the theater of operations to reduce logistical footprint. In addition, technologies from this work provide a better understanding of the battlespace environment as it relates to critical infrastructure. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Systems Response to Threats: In FY06, validated CBR analysis tools in a controlled test facility. In FY07, compare tool analyses to an instrumented Army facility using simulated chemical and biological agents. In FY08, will develop predictive models and algorithms making use of activation energies for deformation and degradation mechanisms based on chemistry (moisture absorption, hygro-thermal effects, and crack growth) for prediction of mechanical properties and durability of fiber reinforced polymer (FRP) composites for facilities and equipment. Will conduct initial research into development of new models governing impacts of waterborne chemical and biological agents on aged pipes and chlorine. In FY09, will evaluate and test simulation algorithms based on failure modes and mechanistic models under interactive conditions. Will also complete development of new models governing chemical agents with aged pipes and chlorine. Will develop new dynamic models governing chemical and biological agent fate and transport in a water distribution environment.	1081	1673	1809	3234
Installation Modeling and Simulation/Fort Future: In FY06, extended simulations for power, water, and fuel infrastructure analysis to forward staging areas. Urban Reasoning and Battlespace Analysis: In FY06, matured methodology to infer utility system topology including simulations to evaluate suitability of infrastructure to support end-to-end deployment activities In FY07, extend methodology to work with incomplete data sets. Network Enabled C2: In FY07, develop algorithms capable of inferring utility network layout from partial information. Develop algorithms to update the utility network layout as additional information is acquired. In FY08, will develop analysis tools capable of identifying and summarizing a utility network_s impact on military operations in urban terrain (MOUT).	1709	1665	1465	
Small Business Innovative Research/Small Business Technology Transfer Programs		39		
Total	2790	3377	3274	3234

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602785A - Manpower/Personnel/Training Technology**	**790**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
790 Personnel Performance & Training Technology	14171	16021	16208	16458	16572	16726	17083	17448

A. Mission Description and Budget Item Justification: The objective of this program element (PE) is to conduct the behavioral and social science applied research that will provide the non-materiel solutions to ensure that Soldiers can adapt and excel and improve the Army's capability to fully leverage advances in networks, systems, and technologies as they evolve. This research provides the scientific basis to recruit, select, assign, promote, educate, train, and retain Soldiers and leaders to comprise a ready and relevant Landpower. This research, where feasible, exploits opportunities to enhance Current Force capabilities. The human science applied research conducted in this program element provides knowledge-products, methods, techniques, and tools that will enable the Army to: select Soldiers who are predicted to perform well in future jobs; assign Soldiers to Military Occupational Specialties (MOS) and jobs that better match their skills and abilities; retain an effective career force through improved strategies and incentives to influence Soldiers to stay in the Army for longer periods of time; accelerate the development of leader critical thinking and interpersonal skills through virtual practice so that junior leaders are more adaptable and prepared for uncertain, rapidly changing missions; develop innovative training strategies for complex battle command skills in network-enabled environments; and design training tools for dismounted squad leadership and team maneuver with ground Soldier systems technologies. Additional research is focused on the training techniques and procedures that will make it easier for trainers and training developers to rapidly respond to changes in mission or operational requirements and provide a more synergistic training and education process (e.g., automated and improved diagnostics, coaching and mentoring, performance measures, and feedback methods). This program leverages efforts and coordinates research with a number of other Laboratories and Research, Development, and Engineering Centers including, the Simulation and Training Technology Center (STTC), Natick Soldier Center, Army Research Laboratory (ARL), and the Communications-Electronics Research, Development, and Engineering Center (CERDEC). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This project is managed by the US Army Research Institute for the Behavioral and Social Sciences (ARI); research in this PE is related to and fully coordinated with efforts funded in PE 0601102-74F and PE 0603007-792.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Personnel: FY06, developed framework that identifies factors likely to influence officer and enlisted Soldier decisions to stay in the Army, identified practices, policies, and conditions relevant to attrition; integrated findings from disparate research over 10 years to enable more complex, interactive examination of decision making; developed new assessment measures that identify knowledge, skills, and attributes (KSAs) required for effective performance in MOS using a sample of MOS, if effective these techniques enable the Army to better match Soldier KSAs with job requirements. FY07, design more precise interactive model of retention and, using model and multivariate analyses, identify strategies emphasizing non-financial incentives (e.g., more choice in assignments, specialized training opportunities, changing branch/MOS, etc.) that could potentially improve retention; collect data from operational Soldiers in selected MOS using KSA assessment measures and evaluate potential to predict preliminary performance data from supervisors; investigate KSA clusters to determine if clustering improves prediction of performance. FY08, will conduct experiments to assess effectiveness of potential incentive strategies by field testing with Soldiers in operational settings; based on findings from the field tests and extent the strategies actually relate to retention decisions, revise model and establish empirical strength of strategies to impact Soldier and Officer behavior; develop improved job performance measures as criteria for the KSA measures and clusters using subject matter experts and Soldiers in operational units within selected MOS. FY09, will further validate incentive strategies and develop guidelines to implement strategies and track	4393	4675	4938	4616

effects on retention; and collect job performance data and supervisor's performance assessments to empirically test KSA measures/clusters for strength in predicting actual job performance and longer-term Soldier success.				
Training: FY06, identified cognitive behaviors underlying expert performance for a set of battle command activities in network-enabled environments; determined training/learning models most applicable to training digital skills, and reviewed basic and applied research on best methods to train cognitive digital skills; developed plans for assessing new approaches to provide feedback in collective training; analyzed the impact of changes in robotic operator control unit design on training efficiency. FY07, develop exemplar training methods, and procedures for commanders and staffs performing battle command in networked-enabled environments; develop preliminary skill retention curves for establishing refresher training schedules to retain critical digital skills; in laboratory experiments, assess the impact of automated feedback alerts on the After Action Review (AAR) process; and identify the collaboration/communication requirements needed between dismounted Soldiers and robotic operators for effective employment of robotic platforms. FY08, will develop tools and techniques to support rapid training development for network-enabled battle command; will develop and validate procedures designed to enhance battle command and dismounted Soldier digital skills and improve skill retention; will develop methods and procedures to assess the value of a network-enabled alternative to the traditional AAR process; and will develop measures of performance for team collaboration in robotic employment for a sample of high priority robotic applications (e.g., battle damage assessment). FY09, will assess methods, techniques, and tools for training battle command that best support the Army Force Generation (ARFORGEN) process; and determine differences in AAR requirements across simulation domains.	3401	3850	3152	3763
Training: FY06, developed exemplar training support packages and guidelines for Future Force Warrior small unit leader cognitive skills training; provided lessons learned from virtual and augmented reality training approaches that were evaluated for their potential to improve future land warrior capabilities; conducted experiments on using augmented reality to train navigation skills and target location; and determined the aviation collective training tasks, techniques, and procedures that could best be supported by virtual and constructive simulation. FY07, conduct lab experiments of training effectiveness of massively multiplayer persistent simulations (MMPS); identify blended learning approaches and technologies (e.g., mixes of on-site learning, distance learning, web-based instruction, classroom instruction, etc.) that have potential application to Army training; and investigate the cognitive processes that mediate the performance of team and collective aviation tasks, and identify overt behavioral metrics for these processes. FY08, will conduct assessment of training effectiveness in multi-national coalition warfare experiment and develop alternative approaches to designing distributed AAR process; will develop alternative blended training approaches and techniques for selected Soldier skills for experimental comparison; and will develop preliminary models for alternative collective training systems incorporating various mixes of training aids, devices, simulators, and simulations (TADSS). FY09, will leverage basic and applied research on intelligent agents and integrate into MMPS environment to use for command post and tactical scenarios; begin experiments to assess the effectiveness of alternative blended training approaches for teaching selected Soldier skills, and improving retention of those skills; and will evaluate alternative models for effectively training collective aviation tasks in laboratory or simulated exercises.	3684	4005	5015	4782
Leader Development: FY06, developed tools to evaluate prototype online self-assessment/feedback module to increase self awareness and improve attention to learning materials; continued development of leadership growth/adult development model to inform research on accelerating the learning process, speeding maturation, and developing adaptive leaders; identified KSAs that leaders will need to perform in future network-centric joint and combined headquarters ops; and conducted and published comprehensive review of last 25 years of research on team performance including meta-analyses of relevant team performance data. FY07, develop protocols and metrics for assessing effectiveness of leader development vignettes in operational tests; design instruments for assessing leader skills and attributes needed for effective performance in high-stress, multi-team, networked systems; and develop prototype training modules for rapid team building. FY08, will collect and analyze data to assess the impact of leader skills and knowledge on performance in joint, interagency,	2693	3220	3103	3297

and multinational (JIM) environments; develop training tools to enhance leader effectiveness in multi-team systems; develop prototype training methods to enhance capability of leaders to take a multicultural perspective for mission success; and identify potential influence techniques leaders can use to be more effective in fighting Global War on Terrorism (GWOT). FY09, will test and evaluate methods and tools designed to improve leader performance in multi-team systems, provide influence techniques that are most effective in GWOT scenarios, and improve leader capability for rapid team building.				
Small Business Innovative Research/Small Business Technology Transfer Programs		271		
Total	14171	16021	16208	16458

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602785A - Manpower/Personnel/Training Technology**	**790**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	14990	16200	15834	15987
Current BES/President's Budget (FY 2008/2009)	48789	51278	51120	52118
Total Adjustments	33799	35078	35286	36131
Congressional Program Reductions		-61		
Congressional Rescissions				
Congressional Increases				
Reprogrammings	-819	-118		
SBIR/STTR Transfer				
Adjustments to Budget Years			374	471

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602786A - LOGISTICS TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	47214	44044	23083	21988	22291	22532	23075	23628
283	AIRDROP ADV TECH	2159	2326	2330	2366	2391	2408	2461	2515
C60	AC60	1586	3658						
E01	Warfighter Technology Initiatives (CA)	26693	18889						
H98	CLOTHING & EQUIPM TECH	12404	14176	15526	14305	14530	14713	15084	15461
H99	JOINT SERVICE COMBAT FEEDING TECHNOLOGY	4372	4995	5227	5317	5370	5411	5530	5652

A. Mission Description and Budget Item Justification: This applied research program element (PE) investigates technologies to improve Soldier survivability and performance for use in the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The PE addresses technologies for: the air delivery of personnel and cargo; combat clothing and personal equipment; and combat rations and combat feeding equipment. The Airdrop Advanced Technology Program (project 283) supports all Services' requirements for air dropping increasingly heavier combat and logistics loads while improving delivery accuracy, minimizing vulnerability of aircraft, and reducing life cycle costs. Investigation of technologies for safer, more combat efficient personnel parachutes addresses a critical capability for rapid deployment force projection, particularly into hostile environments. The Clothing and Equipment Technology Program (project H98) funds cutting edge research and technologies that will enhance warfighter survivability from both combat threats (e.g., ballistics, flame, directed energy) and the field environment (e.g., cold, heat, wet); enhance signature management; provide wearable, conducting materials to augment data and power transmission; provide cooling to the Soldier to reduce risk of heat stress; and lighten the Soldiers' load. Human science is incorporated into modeling and analysis tools that will enable technologists and military users to trade-off potential warrior system capabilities and mature a human-centered warrior system design. The Joint Services Combat Feeding Technology Program (project H99) supports all Military Services, the Special Operations Command, and the Defense Logistics Agency with research conducted on high payoff technologies for performance enhancing combat rations, ration packaging, and combat feeding equipment/systems. Research will enhance nutrient composition and consumption to maximize cognitive and physical performance on the battlefield; minimize physical, chemical and nutritional degradation of combat rations during storage; meet the needs of individual Soldiers in highly mobile battlefield situations; and provide equipment and energy technologies to reduce the logistics footprint of field feeding while improving the quality of food service. The efforts in this PE adhere to Tri-Service Reliance agreements on clothing, textiles, and operational rations and field food service equipment, the last with oversight and coordination by the Department of Defense (DoD) Combat Feeding Research & Engineering Board. Project E01 funds congressional special interest items. Efforts are related to and fully coordinated with those in PE 0603001A (Warfighter Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. Work in this PE is performed by the US Army Natick Soldier Center, Natick, MA.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602786A - LOGISTICS TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	47667	25436	22078	19827
Current BES/President's Budget (FY 2008/2009)	47214	44044	23083	21988
Total Adjustments	-453	18608	1005	2161
Congressional Program Reductions		-168		
Congressional Rescissions				
Congressional Increases		19100		
Reprogrammings	-453	-324		
SBIR/STTR Transfer				
Adjustments to Budget Years			1005	2161

FY09 funds increased to support development of advanced Soldier body armor and protection techologies.

Fourteen FY07 congressional adds totaling $18306 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1870) Flexible Monolithically Integrated Solar Panels
($1582) Improved Shelf-Life in Fresh Fruits and Vegetables
($1917) Adv. Warfighter Sustainment Sys. for 21st Century
($959) Combat Uniform Adv Fabric Treatment Technology
($1246) Biosecurity Research for Food Safety
($958) CoE for High Perform Fibers at Natick Soldier CTR
($958) Chemical & Biological-Protective Hangers (CAB-PH)
($958) Combat Effective Facial Armor
($958) Development of Protective Textile Fabric
($1246) Inorganic Metallic Barriers f/Chem-Bio Structures
($958) Next Generation Chem-Bio Protection Suit
($2780) Precision Guided Air-Dropped Equipment
($958) Solar Powered Refridgerated Container f/Food & Med
($958) Electrochemical Field-Deploy Sys f/Pot Water Gen

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602786A - LOGISTICS TECHNOLOGY**	**283**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
283 AIRDROP ADV TECH	2159	2326	2330	2366	2391	2408	2461	2515

A. Mission Description and Budget Item Justification: This project researches technologies to enhance cargo and personnel airdrop capabilities. These enabling technologies support the goals of Army Transformation for global precision delivery, rapid deployment, and insertion capabilities for force projection, particularly into hostile regions. Areas of emphasis include parachute technologies, parachutist injury reduction, precision offset aerial delivery, soft landing technologies, and airdrop simulation. Efforts will result in increased personnel safety; more survivable and more accurate cargo delivery; and reduced aircraft, crew, and cargo vulnerability. The goal for personnel parachute technology is to reduce injuries and to improve performance and combat effectiveness of the Advanced Tactical Parachute System (ATPS). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, and the Army Modernization Plan. Work in this project is performed and managed by the US Army Natick Soldier Center, Natick, MA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Precision Airdrop Enhancements: In FY06, explored technology (when no commercial solution existed) for advanced pressure, stress/strain, and shape measurement prototype devices suitable as instruments in providing the dynamic response of flexible aerodynamic decelerator systems. In FY07, apply sensor technology to realistic flowfields related to airdrop applications. Investigate state-of-the-art autonomous Guidance, Navigation and Control (GN&C) of precision airdrop systems to improve aerodynamic performance and landings. In FY08, will experiment with favorable GN&C technologies to mature sensing, guidance, navigation, and control algorithms for precision airdrop. In FY09, will downselect and implement the most mature and favorable GN&C technologies into prototypical precision airdrop systems and transition technology to 6.3.	700	835	841	869
Modeling and Simulation for Tactical Parachute System Performance Enhancement: In FY06, developed experimental methodologies providing high level of detail of parachute physics for use with both personnel and cargo parachutes and used an in-house parallel computer cluster to model and simulate parachute control and rate of descent. Developed computer tools to model inflation and to calculate opening shock. In FY07, refine and evaluate computer tools developed to model inflation and to calculate opening shock and use High Performance Computing (HPC) modeling and simulation to investigate fully open parachutist control and rate of descent aspects of ATPS. In FY08, will utilize experimental methodologies to develop detailed knowledge of baseline parachute physics; will complete investigation of fully open parachutist control and rate of descent issues; and will investigate parachute opening phenomena. In FY09, will complete investigation of ATPS parachuting opening and validate full fidelity model against baseline physics from experiments; will provide detailed ATPS performance enhancement assessment to PM-Clothing and Individual Equipment (CIE); and will transition results to PM-CIE ATPS P3I program.	1459	1479	1489	1497
Small Business Innovative Research/Small Business Technology Transfer Programs		12		
Total	2159	2326	2330	2366

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602786A - LOGISTICS TECHNOLOGY**	**E01**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
E01	Warfighter Technology Initiatives (CA)	26693	18889						

A. Mission Description and Budget Item Justification: Not applicable for this item.

Accomplishments/Planned Program: Not applicable for this item.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602786A - LOGISTICS TECHNOLOGY**	**H98**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H98 CLOTHING & EQUIPM TECH	12404	14176	15526	14305	14530	14713	15084	15461

A. Mission Description and Budget Item Justification: This project researches and investigates technologies to improve Soldier survivability and performance. Research focuses on lightweight materials for personal protection and survivability from both combat threats (e.g., improved ballistic, flame, and directed energy) and the field environment (e.g., cold, heat, wet); enhanced signature management; modeling and analysis tools for optimizing Soldier system clothing and equipment; and advances in emerging technology (e.g. nanotechnology, electrotextiles) to improve the performance, multi-functionality, and fightability of Soldier clothing and equipment. The goal of the ballistic protection work is to research and apply advances in materials and materials processing technology to improve the protection and performance of warrior armor systems against conventional and emerging ballistic threats. The supporting biomechanical tools effort will provide a capability to identify promising candidate configurations of extremity armor to provide individual Soldiers with extremity ballistic protection affording flexibility, agility and mobility, while minimizing the energy expended during dismounted operations. The objective of the novel blast protection effort is to characterize blast profiles, determine the hazard, and demonstrate improved protection concepts. The goal of Infantry Warrior Simulation is to build essential analytic tools needed to assess the combat worth of next generation warrior systems, with a focus on network centric warfare technologies. Nanotechnology is being applied to several soldier clothing and equipment areas, and potentially could revolutionize the performance of various Soldier-worn components. The major nanotechnology effort focuses research on conducting, flexible, wearable materials for lightweight power generating and storage devices to augment power sources for Soldier-worn computers and equipment. The purpose of the microclimate cooling effort is to provide a capability that mitigates the effects of heat stress encountered by dismounted infantry exposed to hot environments and encumbered in protective clothing. The goal of the directed energy protection effort is to apply recent developments in nano-materials research to provide the dismounted Soldier with eye protection against tunable-laser threats occurring on the battlefield and to provide improved ballistic fragmentation protection for the eyes, face and neck, and scratch resistance for the lenses. The effort to provide eye protection from tunable-laser threats involves collaboration with ARL on work they are conducting in program element(PE) 0602120 (Sensors and Electronic Devices). This project leverages work performed by the Institute for Soldier Nanotechnologies supported by PE 0601104A (University and Industry Research Centers) and PE 602105A (Materials Technology). The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. Work in this project is performed by the US Army Natick Soldier Center, Natick, MA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Ballistic Protection for the Individual Warrior: In FY06, matured material(s) system(s) architecture for both flexible and composite technology to include resins system, adhesion modifiers, and fiber architecture. In FY07, validate, through testing, technology to enable a 30 percent reduction over current weight (over the FY03 fielded weight level) with equivalent fragmentation protection in flexible and composite configurations; and transition composite technologies for small arms protection to reduce weight and/or increase multiple-hit capability. This technology will transition to PE 0603001A Warfighter Advanced Technology. In FY08, will continue maturation of advanced fiber technology (e.g., carbon nanotube-based) for lightweight armor applications, will investigate conformable material configurations to reduce weight, and minimize performance vulnerability associated with complex shapes in personnel armor applications, and will explore performance thresholds for increased protection levels for personal armor technology. In FY09, will validate performance of selected materials configurations for enhanced helmet performance; will downselect materials and begin integration of technological elements and components into a breadboard system for next generation armor systems and evaluate in various environments.	2420	1928	3273	3700

Novel Blast Protection: In FY06, evaluated Future Force Warrior (FFW) body armor materials against overpressure, continued development of test device for blast protective concepts, refined concept for new Interceptor Vest and began transfer to PEO Soldier of blast protective materials technology concept (materials and application configuration) for use with Interceptor Vest. In FY07, develop an integrated concept for blast protection and validate performance and transition to PEO Soldier development program. In FY08, will define and develop material system concepts for integrated ballistic/blast protection for use in next generation body armor, will investigate alternative surrogate devices for torso injury (other than lung injury) for evaluation of protective concepts. In FY09, will refine and validate material system concepts for integrated ballistic/blast protection for use in next generation body armor, and will validate alternative surrogate devices for torso injury (other than lung injury, e.g., liver, kidney, gut, and spine) for evaluation of protective concepts.	2420	1685	1197	2000
Infantry Warrior Simulation (IWARS): In FY06, completed information centric capability for intra-platoon operations and included it in IWARS version 2.0. This information centric capability was derived from functionalities that included dismounted infantry pertinent data and knowledge elements and the ability to transfer these elements from one Soldier to another through the underlying architecture. In FY07, develop initial small unit battle command module to support small unit information transfer impacts, and release the High Level Architecture compliant version 3.0 IWARS. In FY08, will include Advanced Soldier representations within IWARS, to include effects of sensor systems and the User Defined Operating Picture (UDOP) on the ability to provide actionable information to small units. In FY09, will enhance IWARS to include effects of Netted Communications and Collaborative Situational Awareness (NC/CSA). Will release IWARS version 4.0.	1820	2161	2135	2034
Electrotextiles: Self Powered, Conductive, and Smart - In FY06, developed prototype AA battery photovoltaic (PV) rechargers and PV modules for shelters; began field evaluations of leading PV technologies at Tydall's Renewable Shelter City in collaboration with the Air Force; fabricated 70 feet of novel, live PC fiber and demonstrated the first two-color PV device. Investigated several concepts for highly flexible, stretchable conductors, for Soldier-borne networks. In FY07, mature novel weave and interconnect technologies for PV fibers and explore power generation and electrical conductivity in unique fiber-based compositions; investigate several lightweight, wearable, low profile, connectors, and demonstrate interconnections for current Future Force Warrior electronic systems; investigate new power generating, and electrically conductive textile-based compositions compatible with warrior systems. In FY08, will mature technologies for first active PV fabric and for unmanned PV ground sensors and camo-patterned PVs; will transition flexible conductive networks and connector technologies to shelters and wearable electronics; will investigate current polymer-based optical conductors for secure, non-emissive, high-speed data transmission for optical networks; and will mature new optical materials with high flexibility. In FY09, will integrate a variety of electronic, optical and sensing devices into PV fabrics to demonstrate a new class of self-powered, smart electrotextile applications; will develop wearable connectors and interconnection methods for optical fibers; will explore various textile integration methods to provide additional strength and protection to the optical fibers.	1452	1952	2180	1990
Soldier Borne Microclimate Cooling: In FY06, investigated alternate material and design approaches for reducing the weight and power consumption of cooling technologies by focusing on the maturation of desiccant-assisted evaporative cooling technology and on new technologies for vapor compression cooling (e.g., carbon foam and micro-channel heat exchangers, optimized fan designs, soft packing, and biofeedback for power management). In FY07, downselect material and design approaches, and begin the integration of technological elements and components into a breadboard system. In FY08, will complete the integration of the technological elements and components, and test the breadboard systems. Using the test results, will downselect cooling technologies for Soldier applications and establish a baseline. In FY09, will transition downselected technologies to 6.3 for advanced technology development. Will size, design, and select components for the next generation microclimate cooling device.	721	1444	1222	1190
Soldier Integrated Tunable (Frequency Agile) Laser/Ballistic Eye Protection: This effort addresses the emerging threat of frequency agile	2652	3173	3480	1500

lasers on the battlefield and provides increased ballistic fragmentation protection. In FY06, evaluated laser protection schemes, researched optical limiting concepts that do not require an intermediate focal plane, and improved the performance of ballistic protective materials within the weight limit of the currently fielded system, which is 5.1 oz for a goggle configuration and 1.7 oz for a spectacle configuration. Established experimental protocols to evaluate lens abrasion due to blown sand and defined baselines for subsequent experimental abrasion measurements. In FY07, mature lighter weight ballistic materials while maintaining the improved level of performance; identify and evaluate abrasion resistant coatings and coating application procedures; and research optical limiting concepts that meet system design response time requirements. In FY08, will validate the potential of new ballistic materials achieved through leveraged efforts, will mature hybrid lighter weight ballistic materials while maintaining the improved level of performance, will integrate multi-layered laminates to provide multifunctional transparent armor materials with scratch resistance, and validate optical limiting concepts that do not require a lens system and that meet response time requirements over the visual spectrum. In FY09, if agile laser protective material has met the metric, will combine laser eye protection concepts, compatible ballistic materials, and abrasion resistance coatings into a new composite material; will assemble components on breadboard and perform system evaluation in a simulated environment. If the laser eye protection metric is not met, will transition a lighter weight lens material that provides improved ballistic protection with an improved scratch resistant coating that resists pitting from blowing sand.				
Biomechanical Tools for Individual Soldier Extremity Protection/Optimizing Battlespace Awareness in the Dismounted Soldier: In FY06, defined Soldier performance output measures for extremity worn body armor and equipment, initiated human experiments to collect energy expenditure data and constructed an initial principles-based biomechanical model for the effect of extremity loading on the defined output measures. In FY07, will complete a principles-based biomechanical model that predicts Soldier performance when encumbered with body armor, define performance thresholds for the biomechanical variables, and develop empirically based fatigue model for integration with the principles-based biomechanical model. In FY08, will integrate fatigue prediction into biomechanical model, verify, and validate integrated model, exercise the model to design a prototype set of extremity body armor. Will define cognitive performance metrics related to battlespace awareness (BA), conduct human experiments to evaluate decrements in BA related to physical demands of warfighting, and establish a model for predicting these decrements. In FY09, will define additional complex Soldier output measures for incorporation into biomechanical model, scale biomechanical tools to range of human anthropometry, conduct human experiments to refine fatigue prediction into short term and long term components. Will refine BA model with additional human experimental data and conduct research on strategies for mitigating decrements in BA documented by preceding experiments.	919	1575	2039	1891
Small Business Innovative Research/Small Business Technology Transfer Programs		258		
Total	12404	14176	15526	14305

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602786A - LOGISTICS TECHNOLOGY**	**H99**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H99	JOINT SERVICE COMBAT FEEDING TECHNOLOGY	4372	4995	5227	5317	5370	5411	5530	5652

A. Mission Description and Budget Item Justification: The Joint Services Combat Feeding Technology project researches and applies combat ration and field food service equipment technologies to revolutionize the manner in which we sustain and support the Armed Forces, ensuring optimal nutritional intake. This project supports the Army Transformation in the areas of sustainability and reduced logistics footprint, with goals to demonstrate technology to reduce field feeding logistics by over 75 percent (i.e., weight, cube, fuel, and water) and labor requirements by 50 percent, while improving the quality of food service. Thrust areas include: combat rations; ration packaging; and combat feeding equipment/systems. Near-term goals are to enhance nutrient composition and consumption to maximize cognitive and physical performance on the battlefield. Research methods to reduce ration weight/volume and food packaging waste to minimize the logistics footprint. Tailor rations to the combat situation and provide an "eat on the move" capability, thereby improving mobility. Conduct research to reduce replenishment demand by extending shelf-life, permitting more extensive prepositioning of stocks, while maintaining initial quality. Provide equipment and energy technologies to reduce the logistics footprint and to enhance operational efficiency of field feeding while improving the quality of food service. The work in this project supports all military Services, the Army's Future Force, Special Operations Command, and the Defense Logistics Agency. The Army has Executive Agency responsibility for this Department of Defense (DoD) program, with oversight and coordination provided by the DoD Combat Feeding Research & Engineering Board. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. Work in this project is performed by the U.S. Army Natick Soldier Center, Natick, MA, and this project has collaborative efforts with the US Army Research Institute for Environmental Medicine.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Equipment and Energy Technologies: In FY06, integrated and tested water chiller subsystems for Soldier hydration; completed experimental development and transitioned self-powered tray ration heater to PE 0603001A (6.3); completed experimental design for a solar powered refrigerated container; and completed chemical concept development for air activated exothermic technology for the Meals Ready to Eat (MRE). In FY07, down select four competing Mobile Integrated Sustainable Energy Recovery (MISER) systems to two (a gasifier and supercritical water depolymerization process), verify that both MISERs produce an economically viable quantity of gas from waste, integrate components, and containerize the processors. Complete experimental development, test, and evaluation of individual water chiller. Complete experimental development of two Solar Powered Refrigerated Containers. In FY08, will complete experimental development of an inline water heater as an initial application of flameless combustion; will complete experimental development of an air-activated, self-contained, exothermic, chemical heater for the MRE including all safety/health/environmental regulatory compliance; and will investigate novel cogenerators (2-60kWe and 30-120kWt) for potential to operate on a range of fuels from the MISER producer gas to JP8. In FY09, will complete test and evaluation of the inline water heater (initial application of flameless combustion); will complete experimental development of an ethylene control system for fresh fruits and vegetables. Technologies developed within this effort transition to PE 0603001A, Warfighter Advanced Technology, for further maturation.	1708	2110	2353	2392
Ration Stabilization and Novel Nutrient Delivery Technologies: In FY06, determined statistical significance of anti-inflammatory micronutrients, e.g., quercetin, to extend onset of muscle fatigue and reduce muscle recovery time in animal models. Down selected	1420	1327	1532	1559

representative model ration components for Hybrid Optimal Processing (HOP), utilizing a combination of novel thermal and non-thermal processing targeting meat/seafood and vegetable/starch areas to increase menu variety and warfighter acceptability. In FY07, validate novel delivery systems and optimize nutrient delivery/absorption to enhance First Strike and other individual rations; incorporate encapsulated protein into these rations to assess stability and optimize bioavailability; and verify/evaluate retention of performance enhancers in rations over time by focusing on enhancers requiring protection. Design multiple tray food sterilizer using radio frequencies or microwaves in combination with high pressure. In FY08, will continue incorporation and testing of probiotics, i.e., beneficial bacteria, for improved gastrointestinal health; incorporate selected performance enhancers for delivery via the mouth allowing for the immediate movement of the molecules into the blood; and transition protein encapsulation effort to PE 0603001A. Will validate HOP effectiveness and scale-up design with selected model ration components; plan scale-up HOP design and engineering to produce high quality components; and develop additional shelf-stable combat ration breakfast items and transition to PE 0603001A. In FY09, will evaluate shelf stability of probiotic enhanced ration components; ensure microbiological, chemical stability analyses of advanced shelf-stable meat products; and investigate stability and functional effectiveness of encapsulated oils for ration systems.				
Packaging and Food Safety Technologies: In FY06, tailored food sampling extraction procedures using immunoassays; investigated electrospun nanofiber membranes to help reduce the sampling time from food especially when screening for unknown pathogens; validated array technologies to identify multiple pathogens from a single food sample significantly reducing the number of foods samples needed to identify pathogens; and evaluated self-hydrating pouch forward osmosis technology to reduce weight for the individual warfighter. Evaluated optimized barrier polymer packaging coating technology and producibility to improve resistance to cracking during storage and transitioned to PE 0603001A. In FY07, continue modification and evaluation of food sampling procedures used for biosensor systems to improve their accuracy and sensitivity to pathogenic organisms. Conduct study to assess rates of ration quality degradation using reaction rates (quality kinetics) correlated with sensory analysis. Long term data collected will assist in generating protocols for ration developers and US Army Veterinary Command to more effectively conduct surveillance inspections of rations. In FY08, will continue optimization of array technologies for pathogen detection; and develop database for quality kinetics ration storage study to optimize accelerated storage conditions predictors. In FY09, will investigate multiplexing of electrospun nanofibers for improved capture of pathogens and initiate incorporation into array systems; will investigate molecular beacon signal enhancement as an alternative to identifying pathogens using array-based systems and transition to PE 0603001A; will calculate quality data reaction rates and determine kinetic correlations based on storage studies conducted in FY08; will continue long-term storage study to include extensive analytical, microbiological, and sensory testing; will complete database of quality kinetics and transition to PE 0603001A.	1244	1514	1342	1366
Small Business Innovative Research/Small Business Technology Transfer Programs		44		
Total	4372	4995	5227	5317

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	263507	229893	76544	72584	70754	71665	73197	74884
845	BONE DISEASE RESEARCH PROGRAM	959	989						
863	BTLFLD SURGICAL REPLAC	959							
865	CENTER FOR MILITARY BIOMATERIALS RESEARCH	1916							
866	CLINICAL TRIAL PLEZOELECTRIC DRY POWDER INHALATION	1							
867	DIAGNOSTICS IN TRAUMATIC BRAIN INJURY BLOOD BASED	959							
869	T-MED/ADVANCED TECHNOLOGY	2512	2978	3051	3154	3029	3057	3124	3193
870	DOD MED DEF AG INF DIS	14774	14768	14981	15360	15742	16103	16412	16851
873	HIV EXPLORATORY RSCH	9474	11306	11319	11456	10780	10849	11088	11332
874	CBT CASUALTY CARE TECH	14471	13531	14692	8983	9077	9144	9345	9551
878	HLTH HAZ MIL MATERIEL	9294	13718	14017	14502	13715	13863	14169	14479
879	MED FACT ENH SOLD EFF	9002	9966	10021	10327	9894	9968	10187	10411
953	DISASTER RELIEF & EMERGENCY MEDICAL SVC (DREAMS)	5462							
968	SYNCH BASED HI ENERGY RADIATION BEAM CANCER DETECT	8146	7912						
96C	DIGITAL IMAGING AND CATHERIZATION EQUIPMENT	959							
96I	REMOTE ACOUSTIC HEMOSTASIS	1342							
977	EMERGING INFECTIOUS DISEASES	6757	3560						
FH2	FORCE HEALTH PROTECTION - APPLIED RESEARCH	6787	8309	8463	8802	8517	8681	8872	9067
MA2	DIABETES PROJECT	3258	2077						
MA3	MEDICAL AREA NETWORK FOR VIRTUAL TECHNOLOGY	4888	4253						
OA3	CENTER FOR ADV SURGICAL &	6517	2374						

	INTERVENTIONAL TECH (CA)								
OA5	COMPUTATION PROTEOMICS (CA)	959							
OA7	ELGEN GENE DELIVERY TECHNOLOGY (CA)		1088						
OA8	ENHANCED RES IN TRAUMA PREVENTION/TREATMENT/REHAB	959							
OA9	GENETIC ACUTE ENHANCED BIOWARFARE THERAPY PROG (CA	959							
PA4	WOUND HEALING PROJECT (CA)	959	989						
PA5	NANOFABRICATED BIOARTIFICIAL KIDNEY (CA)	1533	1483						
PA9	PROSTHETIC DEVICE CLIN EVAL AT WRAIR AMPUTEE CTR	5271	5933						
RA2	TARGETED NANOTHERAPEUTICS FOR CANCER (CA)	959							
RA4	TRANSPORTABLE PATHOGEN REDUCT AND BLOOD SAFETY SYS	1199	1088						
RA6	VERSA HSDI (CA)	5750							
TA1	AUTO MEDICAL EMERGENCY INTRAVASCULAR ACCESS (CA)	1438							
TA7	COMBAT CASUALTY CARE FOR BATTLEFIELD WOUNDS (CA)	2684	3857						
UA2	HIGH-SPEED MEMS ELECTROMAGNETIC CELL SORTER (CA)	2875							
UA5	NEUTRON THERAPY (CA)	1725							
UA6	PREDICTIVE TOOLS FOR PTSD (CA)	1438							
UA7	PREVENTIVE MEDICINE RESEARCH INSTITUTE (CA)	1342	1780						
UA8	PROTEIN HYDROGEL (CA)	959	989						

VB3	MEDICAL TECHNOLOGY INITIATIVES (CA)	121569	114176						
X06	HIBERNATION GENOMICS	2492	2769						

A. Mission Description and Budget Item Justification: This program element (PE) supports applied research required to sustain a force of healthy, medically protected warfighters. The primary goal of military medical applied research is to develop medical knowledge and technology (drugs, vaccines, and devices) to effectively protect and improve the survivability of US Forces. This PE funds applied research in the following areas: Militarily Relevant Infectious Diseases including HIV (Human Immunodeficiency Virus); Combat Casualty Care; and Military Operational Medicine (efforts aimed at protecting the Soldier against physiological and environmental degradation). Applied research program development and execution is externally peer reviewed and, to prevent unnecessary duplication, fully coordinated with other Services and Agencies through the Joint Technology Coordinating Groups of the Armed Services Biomedical Research Evaluation and Management Committee.

All medical applied research is conducted in compliance with US Food and Drug Administration (FDA) regulations. The FDA requires thorough testing in animals (referred to as preclinical testing) to assure safety and, where possible, effectiveness (i.e., efficacy) prior to approving controlled clinical trials where these experimental (previously unproven in humans) drugs, vaccines, and medical devices are tested in humans. Subsequent clinical trials are conducted in three phases (Phase 1, 2, and 3) to prove safety and effectiveness of the drug/vaccine/device for the targeted disease/condition, including an increasing number of people in each subsequent phase. Research conducted in this PE primarily focuses on completing preclinical technology maturation activities, although some activities may require use of human subjects to determine preliminary effectiveness when there are no validated animal models.

The Military Relevant Infectious Diseases effort focuses on designing and developing medical protection and treatment against naturally occurring diseases of military importance as identified by worldwide medical surveillance and military threat analysis. Methods identified and matured for prevention and treatment of infectious diseases include candidate vaccines, prophylactic (i.e. preventive measures) intervention, therapeutic drugs, and control of disease-carrying vectors (e.g., mosquitoes, ticks, and mites). HIV Exploratory Research focuses on developing diagnostics, surveillance, epidemiology, and identification of candidate vaccines for prevention and treatment of HIV subtypes found outside the US, which are problematic in military deployments and joint operations with coalition forces.

The Combat Casualty Care effort conducts research to develop knowledge and technologies that can improve medical treatment outcomes for battlefield injuries. Work involves identification and evaluation of drugs, biologics (products derived from living organisms), and diagnostics for resuscitation and life support, as well as trauma care systems for use by forward medics and surgeons. This effort also includes Combat Dentistry research with a focus on prevention of cavities, dental disease, and combat maxillofacial (face/neck) injuries on the battlefield.

The Military Operational Medicine (MOM) effort focuses on biomedical solutions that protect Soldiers and enhance their performance in the face of multiple stressors in operational and training environments. Research matures knowledge and technologies, such as biomedically-valid design criteria for body armor and physiological monitors, to protect Soldiers from injuries from exposure to hazardous environments and materials. This research also examines physiological indicators and associated algorithms/sensors that potentially indicate performance degradation produced by operational stressors such as high altitude, extreme temperatures, hydration, fatigue, isolation, and sleep deprivation.

Work is coordinated and leverages work funded in PE's 0603002A and 0603105A. The cited work is consistent with Strategic Planning Guidance, the Army Science

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and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Walter Reed Army Institute of Research, Silver Spring, MD; U.S. Army Medical Research Institute of Chemical Defense, Aberdeen Proving Ground, MD; U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; U.S. Army Research Institute of Environmental Medicine, Natick, MA; U.S. Army Institute of Surgical Research, Fort Sam Houston, TX; U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; and the Naval Medical Research Center, Silver Spring, MD.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	279780	75407	73951	72517
Current BES/President's Budget (FY 2008/2009)	263507	229893	76544	72584
Total Adjustments	-16273	154486	2593	67
Congressional Program Reductions		-878		
Congressional Rescissions				
Congressional Increases		157050		
Reprogrammings	-16273	-1686		
SBIR/STTR Transfer				
Adjustments to Budget Years			2593	67

Seventy-eight FY07 congressional adds totaling $150524 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($958) Bone Health & Military Medical Readiness
($7668) Synchrotron-based Scanning for Prec Proton Therapy
($2492) Northern CA Institute for Research and Eduction
($958) Rare Blood Program
($2013) Type 1 Diabetes Regeneration Project
($4121) Medical Area Network for Virtual Technology
($2300) Center for Adv Surgical & Interventional Tech
($1055) Elgen Gene Delivery Technology
($958) Rapid Wound Healing Technology Dev Project
($1438) Nanofabricated Bioartificial Kidney
($5750) Applied & Clinical Prosthetic Research Pgm at WRAC
($1055) Transportable Pathogen Reduction & Blood Safety
($3737) Cbt Casualty Care for Battlefield Wounds
($1725) Preventive Medicine Research Institute
($958) Protein Hydrogel
($959) Advanced Proteomics for Clinical Applications
($1822) Biological & Immunological Inf Agent & Cancer Vac
($1726) Biomarkers: Evaluating & Test Acute & Chronic TBI
($1055) Cancer Prevention through Remote Biological Detect
($1247) Center for Diagnosis of Pathogens
($1439) Combat Stress Intervention Program

($1918) CRF Spinal Chord Injury Clinical Trials Res Init
($959) Early & Rapid Analyzer for Heart Attack Diagnosis
($959) Eval of p75 Protein for NS Trea of CNS Trauma
($1535) IC4 Program
($958) Life Science Research Initiative
($959) Medical Image Db Holographic Archiving Library Sys
($1535) Medical Resource Conservation Tech Sys
($4313) Military Complimentary & Alternative Med Research
($16678) Military Molecular Medicine Initiative M3I
($958) MCIS Portable Clinical Information Initiative
($3835) National Eye Evaluation and Research Network
($1390) Neural Controlled Prosthetic Device for Amputees
($1725) Non-Electric Disposable IV Infusion Pump
($958) Online Health Services Optimization
($6519) Orthopaedic Extremity Trauma Research
($958) Orthopaedic Implant Design & Manufactures for TI
($9968) Pain and Neuroscience Center Research
($958) Prevention of Compartment Syndrome
($1581) Respiratory Biodefense Research
($958) Center for Respiratory Biodefense
($958) Silver Foam Technologies Healing Research
($958) Advanced Antimicrobial-Nano Technology
($958) Adv Bioengineering for Enhancement of Solider Surv
($958) Biomedical Materials Initiative
($958) Blast Protection Research
($958) Bone and Tissure Repair and Regeneration Center
($958) Carbon Nanotube Production
($1246) Ctr for Res on Integrative Med in the Military
($958) Center for the Advanced Studies of Brain Injury
($2157) CIC Res for Prev, Diagnosis, & Treatment of Cancer
($1438) Comprehensive Mngt Init for Chronic Diseas (CMICD)
($958) Computer-based Training Methods for Surgical Trng
($958) Dev of Minimally Invasive Cardiac-assist Devices
($479) Diabetes Research - Madigan Army Medical Center
($479) Epigenetic Origin of Disease Res for Casualty Det
($958) High Technology Mass Spectromatry Laboratory

($479) Hydrogen Sulfide Human Health and Disease Research
($958) IDEAnet
($958) Immunostimulating HIV Therapy
($958) Improving Musulaskeletal Health and Function
($958) Infectious Disease Research
($1534) Integrated Multimedia Medical Record
($1917) Lehman Injury Research Center/Ryder Trauma Center
($3834) Military Interoperable Dgital Hospital Testbed
($958) Neuroprosthetics and BioMEMS Development Project
($3163) Neutron/Hadron Particle Therapy
($958) Parallelavax Rapid Vaccine Testing Technology
($958) Rapid Prototyping Prosthetic Limbs
($958) Reservist Medical Simulation Training
($958) Robotic Surgical System
($1054) Sci, Humanitary Inter, Educ, Learning f/Disasters
($958) Storage Area Network Impl - Eisenhower Med Center
($958) Synthetic Malaria Vaccine Research
($958) Targeted Nanotherapy f/Adv Breast & Prostate Cance
($958) Viral Immunology Center Rapid Pathogen ID
($2013) Weapons Agents Bio-Defense Analysis Program
($2683) Hibernation Genomics

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**	**869**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
869 T-MED/ADVANCED TECHNOLOGY	2512	2978	3051	3154	3029	3057	3124	3193

A. Mission Description and Budget Item Justification: This project funds applied research in the design and development of physiological status monitoring technology that enables remote monitoring of the Soldier to provide commanders and medics information on health and performance, including performance status (tracking changes in warfighter physical characteristics and physiological capacities), casualty avoidance (preventing environmentally-related non-battle injuries) and wound detection (a signal identifying the occurrence of a wound). The focus is on developing the reliable interpretation of signals from a wearable, integrated system that can monitor Soldier physiological status and provide actionable information. It enables personnel to quickly and accurately determine that a Soldier is fully functional, impaired but still capable of functioning, or in need of medical attention. This information would also be useful in planning the evacuation and treatment of casualties. Work includes identification and initial development of parallel and supporting technologies including medical informatics (science of organizing and interpreting medical information), medical artificial intelligence, and data mining tools that develop predictors of detrimental physiologic changes. Work is performed in coordination with Natick Soldier Center (NSC) and the Future Force Warrior (FFW) program. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by U.S. Army Research Institute of Environmental Medicine (USARIEM), Natick, MA; U.S. Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX; and the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Physiological/Life Sign Monitoring: In FY06, completed integration of the sensor suite and algorithms (heart rate, respiration, body posture and activity, ballistic wound detector, fluid intake, sleep status) using wireless body area network technologies. Evaluated performance with the FFW soldier ensemble; completed integration of the initial capability Warfighter Physiological Status Monitoring (WPSM) with FFW Advanced Technology Demonstration; evaluated relationships among variables that signal cardiovascular collapse. WPSM initiatives are coordinated with related efforts in the US Army Medical Research and Materiel's Combat Casualty Care research program. In FY07, evaluate the Spartan network (SPARNET) prototype at the Ranger Training Brigade (RTB); assess its ability to track student hydration, and geo-location; evaluate system scalability and contribution to RTB situational- and medical-awareness, for example, linking data to the Fort Benning Local Area Network to provide a tool to prevent heat casualties in training environments. Evaluate technologies that provide medics with noninvasive measures of human tissue changes that predict shock by blood loss and aid diagnosis of collapsed lungs. In FY08, will test validity of near real-time SPARNET-enabled model predictions of hydration requirements and heat strain using physiological and weather data. Predictive modeling and simulation will be used to support improvements in training doctrine and individual equipment. In FY09, will complete final testing prior to transition of SPARNET-enabled WPSM technologies to the 5th RTB (mountain phase) and 6th RTB (swamp phase), and evaluate training improvements. Conduct experiments with human test volunteers to non-invasively simulate blood loss and to support the development of algorithms to aid in shock prediction.	2512	2920	3051	3154
Small Business Innovative Research/Small Business Technology Transfer Programs		58		
Total	2512	2978	3051	3154

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**	**870**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
870 DOD MED DEF AG INF DIS	14774	14768	14981	15360	15742	16103	16412	16851

A. Mission Description and Budget Item Justification: This project supports applied research on medical countermeasures to naturally occurring infectious diseases that pose a significant threat to the operational effectiveness of forces deployed outside the United States. Preventive countermeasures would protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations. Of major importance to the military are malaria, bacterial diseases responsible for diarrhea (i.e., caused by Shigella, enterotoxigenic Escherichia coli (ETEC), and Campylobacter), and viral diseases (e.g., dengue fever and hantavirus). This project explores improved materiel to control disease transmission by insects, ticks, and other organisms (vectors) that transmit diseases to humans, thus reducing incidence of these diseases. It also addresses a variety of other infectious disease threats to mobilizing forces, including leishmania, meningitis, viral encephalitis, scrub typhus, and hemorrhagic fevers. Improved diagnostic capabilities will enable rapid battlefield identification important for a commander's medical situational awareness and physician's intervention. Major goals include the discovery and application of new technologies including integration of genomic (DNA-based) and proteomic (protein-based) technologies into vaccine and drug discovery; developing broad spectrum vaccines that can protect against multiple disease strains; and developing improved drugs to prevent or treat malaria. For development of drugs and biological products, preclinical studies in the laboratory and in animal models assess safety, toxicity and effectiveness and are necessary to provide evidence to the Food and Drug Administration to justify approval for that product to enter into future human clinical trials. Additional non-clinical studies are often needed even after candidate products enter into human testing, usually at the direction of the Food and Drug Administration to assess potential safety issues. Drug and vaccine development bear high technical risk; of those candidates identified as promising in initial screens, the vast majority are eliminated after additional safety, toxicity, and/or effectiveness testing. Work is managed by the US Army Medical Research and Materiel Command. As the lead Service for infectious diseases research within the DOD, the Army is responsible for programming and funding all research on joint and Service-specific requirements, thereby precluding duplication of effort within the Military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD, and its overseas laboratories; the US Army Medical Research Institute of Infectious Diseases (USAMRIID), Fort Detrick, MD; and the Naval Medical Research Center (NMRC), Silver Spring, MD, and its overseas laboratories.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Drugs to Prevent/Treat Parasitic Diseases: Conduct studies to investigate new candidate drugs. Continue to assess and improve current candidate drugs for prevention and treatment of malaria and/or leishmania, selecting the most effective and safe candidates for continued development. The malaria parasite becomes resistant to the currently licensed drugs making it necessary to continually search for new drugs to maintain the developmental pipeline. In FY06, tested prophylactic (preventive) antimalarial drugs and identified promising candidates for further assessment and validation; identified drugs with known antileishmanial activity for possible further development; continued preclinical testing of a new, safer drug (artesunate) to treat severe malaria. In FY07, assess, design, or disqualify candidate drugs against malaria and leishmania, introducing novel approaches identified in basic research, and continue to refine promising candidates in the developmental pipeline. In FY08, will continue studies to assess, design, or disqualify candidate drugs identified in the drug discovery program. In FY09, will continue effort to test new drugs against malaria and/or leishmania, identified in discovery programs, for applicability as new countermeasures against these disease threats, maintaining a pipeline of new technologies to counter the threat from malaria.	5387	6400	8490	9068

Bacterial Threats Vaccine Programs: Conduct studies to design and assess antibacterial vaccine candidates to prevent diarrhea and dysentery (a threat to deployed troops), meningitis (a threat to trainee and deployed troops), and scrub typhus (a debilitating disease that is developing resistance to the only treatments available). In FY06, continued to study and validate potential of vaccines against the three major bacterial causes of diarrhea and dysentery. Continued to genetically modify one of the bacteria causing meningitis against which the current vaccine is not effective, for use in manufacturing a more broadly protective vaccine. Successfully demonstrated protection against scrub typhus in a mouse model using a candidate protein-based vaccine and constructed scrub typhus DNA-based vaccine to demonstrate DNA vaccine technology in animal models. In FY07, continue to design and validate potential vaccine candidates against diarrhea, meningitis and scrub typhus, including assessment of new vaccine strategies and of candidate vaccines against diarrhea; complete improved version of meningitis vaccine for assessment in animals; and assess new and revised scrub typhus DNA and protein vaccines in mouse model based on lessons learned in FY06. In FY08, will refine anti-diarrhea vaccine candidates and assess a potential vaccine made of bacterial proteins associated with the bacteria adhering to the gut; establish a model of dysentery (bloody diarrhea caused by Shigella) in nonhuman primates; complete preclinical evaluation of new diarrheal and meningitis vaccines. In FY09, will continue systematic examination of potential adhesion bacterial proteins as new vaccines and other countermeasures against diarrhea; continue genetic modification of meningitis bacteria based upon ongoing efforts to improve range of protection induced in animal models, and test new scrub typhus proteins as potential candidates in a broadly protective vaccine.	4620	3942	2348	2146
Insect Vector Control and Infectious Disease Diagnostics Programs: Develop interventions that protect warfighters from insect bites that transmit diseases and design new medical diagnostic and surveillance tools for the field. Sand flies can transmit Leishmania and different species of mosquitoes can transmit dengue fever and malaria. In FY06, assessed a sand fly field identification system and sand fly control materials including insecticides and disease detection systems for use by Preventive Medicine Units. Tested new insect repellents as possible replacements for the current military repellent. Evaluated and/or refined clinical laboratory tests compatible with standard military lab diagnostic systems and rapid tests for use by physicians in clinics for diagnosis of several militarily important diseases (dengue fever, diarrheal agents, malaria, and leishmania). In FY07, conduct studies to find better ways to protect from insect-borne diseases and to improve medical diagnostic capabilities in the field. Refine field pathogen detection kits; continue to assess sand fly preventive medicine materials and an improved standard bed net that is an effective barrier to the tiny sand flies. Continue to develop improved laboratory diagnostics for malaria and diarrheal diseases. In FY08, will refocus effort to reduce disease threat from insects other than sand flies including testing of insect-based pathogen detection assays; downselect a new insect repellent for final formulation, and continue to improve medical diagnostic capability in the field. Assess individual and combined components of diagnostic tests for selected infectious disease agents and begin design of next-generation diagnostic assays. In FY09, will investigate new interventions methods that reduce/prevent biting by insect vectors and will design and evaluate new medical diagnostic and surveillance tools for the field to improve the medical response to threats for which solutions have not been found.	1462	2040	2071	2137
Viral Threats Vaccine Programs: Design and test new vaccine candidates against dengue and hantaviral hemorrhagic fever viruses (infections resulting in internal bleeding) and assess newer technologies to protect against other lethal viral diseases. In FY06, conducted preclinical studies of second-generation dengue vaccine; established method to rapidly screen samples from vaccinated persons to determine if they had a response to the vaccine; demonstrated that a DNA vaccine for a second hantavirus strain could protect against that strain in an animal model; and continued preclinical studies of DNA vaccines for hantavirus. In FY07, continue developing and testing new vaccine candidates against dengue and hantaviruses, and assess new technologies to protect against other lethal viral diseases. In FY08, will evaluate new antiviral vaccines against newly identified emerging viral threats, and conduct preclinical studies of a combined DNA vaccine against several highly lethal viruses including Rift Valley fever, Crimean Congo hemorrhagic fever, and tick-borne encephalitis. In FY09, will continue to assess and evaluate new antiviral vaccines and examine use of human antibodies (protective	3305	2373	2072	2009

immune proteins found in the blood) as an alternative approach to vaccines for protecting or treating viral disease threats.				
Small Business Innovative Research/Small Business Technology Transfer Programs		13		
Total	14774	14768	14981	15360

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**	**873**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
873 HIV EXPLORATORY RSCH	9474	11306	11319	11456	10780	10849	11088	11332

A. Mission Description and Budget Item Justification: This project supports the medical technology area of the Future Force by conducting applied research and development of improved diagnostics, surveillance, and epidemiology (the study of the causes, distribution, and control of disease in populations), and candidate vaccines for prevention and treatment of Human Immunodeficiency Virus (HIV) infection. HIV is the virus that causes the disease of Acquired Immunodeficiency Syndrome (AIDS). This program is jointly managed through an Interagency Agreement between the US Army Medical Research and Materiel Command (USAMRMC) and the National Institutes of Allergy and Infectious Diseases. Main efforts include development and preclinical studies (studies required before testing in humans) of candidate vaccines, such as small animal and nonhuman primate studies, as well as laboratory methods to assess vaccine protection, improved diagnosis of HIV infection, and improved prognostic assessment and disease management of HIV-infected individuals. This project contains no duplication with any effort within the Military Departments or other government organizations. Work is related to and fully coordinated with work funded in PE 0603105, project H29. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD, and its overseas laboratories; and the Naval Medical Research Center (NMRC), Silver Spring, MD, and its overseas laboratories. Most work is conducted under a cooperative agreement with the Henry M. Jackson Foundation (HMJF), Rockville, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
HIV Research Program: Conduct projects assessing new HIV vaccine candidates, vaccine test site development worldwide, assessment of HIV disease outbreaks, and genetic assessment of HIV threat. In FY06, continued preclinical testing of candidate vaccines; conducted global surveillance and genetic analyses of new emerging HIV subtypes (genetically divergent strains) collected by DOD; developed new international field trial sites; continued US Military Clinical Intervention Network (MCIN) operations to study the frequency and impact of HIV/AIDS in/on military populations; and continued technical watch for new drugs that protect against HIV/AIDs. In FY07, continue with assessment of new HIV vaccine candidates, additional vaccine test site development in Africa and Asia, and epidemiological and genetic assessment of the HIV threat. Continue vaccine testing using a "prime-boost" vaccine strategy (using a combination of two different vaccines to try to induce strong and long-term protective immune response); evaluation of animal and human physiological responses that correlate with disease protection for assessing effectiveness of vaccines in humans; and assessing novel vaccine strategies. In FY08, will continue ongoing long-term candidate vaccine refinement based on the studies of the globally-prevalent HIV viral subtypes; continue to improve methodologies for medical monitoring of DOD personnel's viral exposure and infection; and continue to improve and integrate new methods to assess effectiveness of candidate vaccines in support of clinical research (tests in humans). In FY09, will continue the long-term efforts to find solutions to the HIV threat to DOD personnel with ongoing studies directed at assessing new HIV vaccine candidates, vaccine test site assessment and development in Africa and Asia, and assessment of continuing changes in global risk and genetic makeup of HIV threat to US forces to help direct future research and intervention programs.	9474	11007	11319	11456
Small Business Innovative Research/Small Business Technology Transfer Programs		299		
Total	9474	11306	11319	11456

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February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**	**874**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
874 CBT CASUALTY CARE TECH	14471	13531	14692	8983	9077	9144	9345	9551

A. Mission Description and Budget Item Justification: This project supports applied research to develop and assess the feasibility of concepts, techniques, and materiel that improve survivability and assure better medical treatment outcomes for warfighters wounded in combat and military operations other than war. The focus is on improving the effectiveness of medical treatment in the pre-hospital setting and during evacuation. Major areas of emphasis include hemorrhage control (novel bandages and techniques), resuscitation (fluid replacement and oxygen delivery), prognostics and diagnostics (predictive indicators, decision aids, and devices for triage), life support (computerized monitors and autonomous patient care devices), and repair (novel treatments to minimize tissue damage and accelerate restoration of function). This project also funds research to enable better medical training for Soldiers, medics, and other battlefield medical personnel, to reduce evacuations due to dental disease, and reduce the medical logistics footprint (weight, cube, number of personnel) on the battlefield. For development of drugs/biological products/medical devices, preclinical studies in the laboratory and in animal models assess safety, toxicity, and effectiveness and are necessary to provide evidence to the Food and Drug Administration to justify approval for that product to enter into future human clinical trials. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the US Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX; the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA; and the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Hemorrhage Control, Blood, and Resuscitative Fluids-including materials and systems for minimizing the effects of traumatic blood loss, preserving blood and blood products, and trauma resuscitation: In FY06, identified new products for intravenous control of bleeding; evaluated freeze-dried plasma (alternative to frozen plasma); identified a product derived from blood components that causes coagulation to restore clotting function in wounded Soldiers for further study; investigated damage to blood products as a result of storage over time; demonstrated survival benefit of resuscitation with whole blood; and developed preclinical model of blast trauma. In FY07, complete stability studies of freeze-dried plasma prior to beginning human trials; select best method to inactivate disease-causing agents in blood to prevent disease transmission from transfusions; develop preclinical models of abnormal blood clotting in combined injury, bleeding and massive resuscitation model; define resuscitation strategies to correct abnormal clotting; begin to engineer a nonperishable fluid to mimic fresh whole blood; complete comparative experiments to determine the best new fluid for resuscitation; and select the most promising additive to reduce tissue and organ injury, inflammation and the shock in severely injured patients. In FY08, will identify new strategies to treat the abnormal blood clotting response in severely injured patients; establish effects of resuscitation to treat blast-trauma-hemorrhage on brain and lung; determine if red cells lose efficacy near the end of their shelf life. Also, will test products and methods of using a foam blood clotting agent to stop internal bleeding. In FY09, will identify specific diagnostic and therapeutic interventions for abnormal blood clotting from the candidates identified in FY08 and optimize resuscitation strategies for blast-trauma-hemorrhage on brain and lung in small animal models. Investigate methods to freeze-dry red cells.	7188	6050	7747	5138
Combat Trauma Therapies-including identification and development of candidate drugs and medical procedures to minimize the effects of combat injuries: In FY06, evaluated several devices which use infrared light to assess wound cleaning and tissue health in animal models; selected best material for repair of bone defects; used the Penetrating Head Injury (PHI) animal model in further studies to evaluate the	1992	3800	4000	1552

body's responses to a PHI. The head injury effort is coordinated with related efforts under the Military Operational Medicine Research Program in PE 0602787A, project 878. In FY07, begin a long-term collaborative effort to restore function of limbs by reducing infections and regenerating skin, muscle, and bone in battle-injured extremities; evaluate a method of cooling the brain as a neuroprotection therapy, and study a drug to enhance brain function as post-injury rehabilitation for brain trauma. In FY08, will assess emerging therapeutics (stem cell therapy, growth factors) in animal models and assess new methods to repair areas with major injuries caused by projectiles; develop selective brain cooling and neuroregeneration for early intervention and treatment; establish neuroprotection initiatives on neuroregeneration methods to reduce death and sickness resulting from brain trauma including stem cell therapies, tissue grafts, and a drug to improve new learning and memory; complete studies of FDA-licensed drugs that are anti-seizure candidates for Silent Brain Seizure (SBS) therapy; and design a prototype device for brain injury diagnostics. In FY09, will focus tissue regeneration activities on the most promising clinical treatments in blood vessel grafts, muscle regeneration, regeneration of bones in the head and face; and preclinical assessment of long-bone regeneration; will continue to refine selective brain cooling and neuroregeneration for early intervention and treatment; and conduct drug combination studies for the treatment of acute brain trauma.				
Far-Forward Medical Systems-including diagnostic and therapeutic medical devices and associated algorithms, software and data processing systems for resuscitation, stabilization, life-support, surgical support, and dental care treatments that can be applied in a pre-hospital, operational field setting: In FY06, completed preclinical evaluation of a software algorithm for automated fluid resuscitation based on blood pressure, which works for all currently-available resuscitation fluid types; assessed performance of the Warfighter Physiological Status Monitoring (WPSM) with the Future Force Warrior ensemble; continued experiments to provide additional data for identification of markers of impending shock through refinement of algorithms; identified simple medical measurements such as variability of heart rate as a signal of impending cardiovascular collapse requiring life saving intervention; completed several toxicity and formulation studies of a compound (antimicrobial/antiplaque) to prevent tooth decay. The WPSM activities are coordinated with related efforts under the Military Operational Medicine Research Program in PE 0602787A, project 869 and PE 0603002, project 800. In FY07, complete preclinical evaluation of a software algorithm for automated ventilation and oxygen administration based on lung mechanics and blood gas measurements; and complete remaining toxicity and formulation studies on the antimicrobial, antiplaque compound. In FY08, will complete preclinical evaluation of simultaneous operation of closed loop control of ventilation, oxygen administration and fluid administration and identify, from a number of candidates, a hardware platform. In FY09, will complete preclinical evaluation of oxygen, ventilation and fluid resuscitation algorithms in an integrated hardware platform (either the Army's integrated litter or the Navy's Lightweight Trauma Module) for casualty transport.	4834	2200	1186	1228
Combat Casualty Bioinformatics and Simulation-focuses on a data management system to capture and analyze time series data such as heart and respiration rates over time, and development of casualty simulations and durable, realistic simulators for initial and reinforcement training of care providers: In FY06, improved database user interfaces and incorporated features to allow storage of data from additional studies; and finalized technical testing of prototype Advanced Medic Training Technologies system, designed to teach medics basic skills. In FY07, refine components of a deployable medical simulation training system for reinforcement training of far-forward care providers and design new technologies to add to simulators that depict realistic battlefield injuries to train combat medics in treatment of severe trauma. This effort builds upon previous medical simulator technology effort through the introduction of simulated skin, flesh and blood. This will increase realism of models to reduce the need for live tissue (animal) training for trauma treatment. In FY08, will complete prototype patient trauma simulations with advances in material sciences that depict realistic skin, flesh, blood, bone, fluids, and organs, as well as sensor (detects and provides feedback on medic interventions) and simulated fluid loss technologies. In FY09, will support testing and perform evaluation of the trauma simulation components developed in a joint RDECOM/MRMC effort to assess training effectiveness at Army Medical Department Center and School and other military training venues.	457	1290	1759	1065

Small Business Innovative Research/Small Business Technology Transfer Programs		191		
Total	14471	13531	14692	8983

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**	**878**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
878 HLTH HAZ MIL MATERIEL	9294	13718	14017	14502	13715	13863	14169	14479

A. Mission Description and Budget Item Justification: This project supports the Medical and Survivability technology areas of the Future Force with a focus on providing Soldier protection from health hazards associated with materiel and operational environments. Emphasis is on identifying health hazards inherent to the engineering design and operational use of equipment, systems, and materiel used in Army combat operations and training. Major areas of emphasis include battlefield lasers, ballistic, and mechanical injury (e.g., models of protection by soft body armor), health hazards of operations in environmental extremes, and toxic environments. Specific hazards addressed include blast overpressure generated by weapons systems, toxic chemical hazards associated with deployment into environments contaminated with industrial and agricultural chemicals (which compliment ongoing Defense Threat Reduction Agency initiatives for chemical/biological threat agent detection), directed energy sources (laser), and environmental stressors (heat, cold, and high altitude). Specific research tasks include characterizing the extent of exposure to potential hazards; delineating exposure thresholds for illness, injury, and performance degradation; establishing biomedical databases to support protection criteria; and developing and validating models for hazard assessment, injury prediction, and health and performance protection. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA; the United States Army Center for Environmental Health Research (USACEHR), Fort Detrick, MD; and the US Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Laser Protection Research: In FY06, completed assessment of advanced therapy (anti-inflammatory treatment with FDA-licensed drugs) for the treatment of laser exposure from military systems; Updated Army Regulation AR 11-9, (Army Radiation and Safety Program, which established safe exposure limits for laser radiation in the near infrared wavelength range) by augmenting it with laser eye injury threshold limits for exposure pertinent to military systems, after coordination with the American National Standards Institute. In FY07, examine candidate drug therapy interventions for laser-induced eye injuries and monitor recovery rates of nerve fibers, which are responsible for eye-to-brain data transmissions. In FY08, will complete functional assessment of visual acuity recovery in a behavioral model based on emerging laser injury research to determine the best eye injury treatment approach; and will refine a strategy for combined drug therapies in treatment of laser and trauma-induced eye injuries (blast, fragments). In FY09, will utilize animal testing to assess laser eye injury hazards from advanced military systems. Will evaluate a combination of drugs for treatment of laser induced eye injury.	2204	1694	1960	2706
Injury Protection (face/eye): In FY06, produced dose-response models, i.e., models that compare injury type and severity with projectile characteristics, that predict varying levels of eye injury severity as a result of projectile impacts such as those caused by secondary blast effects. These predictive models of injury risk are available for use by the US Army Soldier Systems Center, Natick MA, to enhance their development of protective equipment. In FY07, use laboratory tests and injury trend data to assess computational and physical models of the face and eye, and propose injury-based protection criteria. In FY08, will validate and transition physical model and face/eye injury dose-response models to Army materiel developers. In FY09, will design an impact test methodology for assessing face shield performance.	2016	3661	3613	3221
Pulmonary Hazards and Risk Assessment Models: In FY06, validated a body armor blunt trauma test device with animal injury data and	2183	4482	4530	5070

released a body armor blunt trauma testing method with human injury prediction software to the Research, Development, and Engineering Command/Natick Soldier Center. This new testing method enables body armor developers to test novel ballistic materials for lighter body armor. Conducted small-animal tests to establish dose-response effects of inhaled hydrogen chloride (a typical component of fire gases generated behind defeated vehicle armor) to help refine the Toxic Gas Assessment Software-Performance Evaluator (TGAS-PE) model that predicts human injury and performance decrements resulting from exposure to inhaled fire gases. In FY07, develop assessment software that predicts lung damage progression caused by blunt impacts and severe injuries. Conduct large-animal tests to determine the effects of inhaled toxic fire gases on physical performance. In FY08, will develop an integrated model that will predict lung injury and performance outcomes from exposures to combined insults of blast over-pressure and blunt trauma. Will collect experimental data required to expand the scope of the TGAS-PE model to predict the impact of inhaled fire gas exposures on physical performance. In FY09, will use new and existing animal injury and performance data to validate the integrated blast overpressure/blunt trauma lung injury and performance model. Will use large animal performance data to validate the TGAS-PE model for performance impacts from exposure to inhaled toxic fire gases and release TGAS-PE1 (performance) to survivability assessors for live-fire vehicle testing.				
Biomonitor System/Dehydration Research: In FY06, tested a set of toxicity sensors and selected best candidates for incorporation into an environmental sentinel biomonitor system to allow rapid identification of toxicity levels in drinking water samples. Determined that dehydration degrades performance during high-altitude missions but does not degrade performance in cold environments, and modified existing medical doctrine based on findings. In FY07, design and verify models to predict water needs for a broad spectrum of modern missions in environmental extremes; complete laboratory testing of an environmental sentinel biomonitor platform that integrates toxicity sensor information to provide rapid analysis of drinking water quality; and refine and validate models to predict water needs for a broad spectrum of modern missions in environmental extremes. In FY08, will conduct field testing of the environmental sentinel biomonitor system to demonstrate capability to rapidly assess drinking water quality and provide relevant health risk information to decision makers on toxic hazards in water. Will conduct laboratory studies using human subjects data to assess the effects of nutritional countermeasures (such as caffeine) on fluid balance and performance when working in hot environments. In FY09, will assess technologies for rapidly identifying chemical contamination by Toxic Industrial Chemicals (TICs) and that are appropriate for use with field water production equipment. Will conduct field test to evaluate novel hardware solutions, such as on-the-move enhanced fluid and nutrient delivery systems to enhance fluid and electrolyte delivery to Soldiers.	2891	3617	3914	3505
Small Business Innovative Research/Small Business Technology Transfer Programs		264		
Total	9294	13718	14017	14502

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**	**879**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
879 MED FACT ENH SOLD EFF	9002	9966	10021	10327	9894	9968	10187	10411

A. Mission Description and Budget Item Justification: This project supports applied research with a focus on sustaining and enhancing Soldier health and performance during military operations in the full spectrum of military environments. Emphasis is on identification of baseline physiological performance and assessment of degradations produced by operational stressors. The resulting databases and collection of rules and algorithms for performance degradation in multi-stressor environments form the basis for the development of behavioral, training, pharmacological, and nutritional interventions, including psychological debriefing, to prevent degradation in Soldier health and sustain Soldier performance. Key stressors include psychological stress from isolation, new operational roles, frequent deployments; inadequate restorative sleep; prolonged physical effort, and inadequate hydration in extreme environments. Will also assess the adverse effect of shifting biological rhythms during deployments across multiple time zones (extreme jet lag), night operations, and thermal and altitude stress. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA; and the US Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
High Altitude Research: In FY06, evaluated potential changes to pre-deployment doctrine that addresses requirements for the acceleration of altitude acclimatization. Designed and evaluated a high-carbohydrate diet for reducing the incidence of acute mountain sickness and determined that this nutritional approach was more effective than traditional creatine or antioxidant supplements. Discovered that partial acclimatization of individuals to altitude (e.g., living at Fort Carson) provides nearly complete protection against altitude effects at altitudes as high as 12,600 feet (the Army's Pike's Peak Laboratory). Completed altitude chamber studies with intermittent hypoxia exposure (exposure to air with lowered oxygen content) that indicated utility of this method to substantially reduce acclimatization time. In FY07, refine predictive models of altitude acclimatization and complete studies to determine how to optimally accelerate high altitude acclimatization through intermittent exposure to reduced levels of oxygen. In FY08, will integrate doctrinal and technological components into the prototype Altitude Readiness Management System (ARMS), a personalized digital assistant device designed to use altitude and physiological modeling data to monitor individual susceptibility to adverse health and performance at high altitudes. ARMS will provide an enhanced planning and prediction capability. In FY09, will reexamine approaches to reduce performance degradation caused by altitude illness by evaluating the benefits of various drug interventions.	2425	2686	2888	2657
Fatigue/Sleep Research: In FY06, developed an initial laboratory version of the Fatigue Intervention and Recovery Model (FIRM) that predicts the amount of sleep recovery needed for military units following a period of extended sleep restriction allowing optimization of Soldier recycle rate. FIRM also provides an estimate of the variability of the performance prediction based on the quality and amount of data input, and makes some initial predictions on the effects of a fatigue countermeasure on psychomotor performance, for example, caffeine's effects on performance measures such as reaction time and ability to sustain vigilance. In FY07, conduct field studies to improve Soldier effectiveness predictions and assess the efficacy of drug countermeasures for individual Soldiers. In FY08, will conduct laboratory studies to assess predictions of performance effectiveness and the efficacy of drug interventions for individual Soldiers. In	1194	1590	1712	1682

FY09, will further integrate components of the next-generation FIRM, which will include enhanced capability for prediction of the effects of stimulants, into the Sleep History and Readiness Predictor (SHARP).				
Mental Health Research: In FY06, conducted two field tests that assessed the effectiveness of strategies such as psychological debriefing following traumatic events in reducing psychiatric illness in soldiers. The results of these studies may help to improve the mental health of Soldiers returning from deployments in Iraq. In FY07, determine the impact of deployment length and frequency of deployments in identifying unit/individual characteristics that enhance resilience. In FY08, will assess individual intervention strategies such as DoD post-deployment health assessment and post-deployment reassessments, leader development tools such as pre-deployment-battlemind-training, and Soldier and leader training modules including post-deployment-battlemind-training and spouse battlemind training. In FY09, will develop unit-level intervention tools for military-wide implementation to improve warfighter resiliency, health, and performance.	2848	3153	2835	3600
Vision and Auditory Research: In FY06, evaluated performance of hearing enhancement and protective devices for mounted and dismounted warfighters; conducted a Vice-Chief of Staff Army-directed feasibility study to replace the combat vehicle crewman helmet with the Army Combat Helmet and a headset. As a result of this study the decision was made not to replace the combat vehicle crewman helmet with the Army combat helmet and headset. These findings will reduce the incidence of trauma-based hearing loss among deployed to Iraq. In FY07, use data generated in human and animal studies to initiate evaluation of a hearing damage model, Auditory Hazard Assessment Algorithm for the Human Ear, to assess its utility in performing auditory health risk assessments and guiding development of hearing protection devices. In FY08, will conduct preclinical studies to compare the effectiveness of various pharmacological agents (such as antioxidants) in preventing and treating acoustic trauma. In FY09, will complete studies required to verify utility of the Auditory Hazard Assessment Algorithm for the Human Ear in predicting hearing loss and guiding development of hearing protection devices.	2535	2450	2586	2388
Small Business Innovative Research/Small Business Technology Transfer Programs		87		
Total	9002	9966	10021	10327

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602787A - MEDICAL TECHNOLOGY**	**FH2**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
FH2	FORCE HEALTH PROTECTION - APPLIED RESEARCH	6787	8309	8463	8802	8517	8681	8872	9067

A. Mission Description and Budget Item Justification: This project supports applied research directed toward the sustainment of a healthy force of warfighters from accession through retirement. This research focuses on enhanced protection of Soldiers against health threats in military operations and training. Stressors that adversely affect individual Soldier health readiness are identified and studied in order to develop interventions that will protect Soldiers and improve their health and performance in stressful environments. This is follow on research that extends and applies findings from a decade of research on Gulf War Illnesses (GWI) and other chronic multisymptom illnesses that have suspected nerve and behavioral alterations due to environmental contaminants and deployment stressors. Force Health Protection (FHP) applied research is conducted in close coordination with the Department of Veterans Affairs. The program has the following three major thrust areas: (1) global health monitoring; (2) health behavior interventions and health risk communication (e.g., weight management and benefits of exercise); and (3) health risk assessment methods and medical materiel safety (e.g., interactions of operational stressors (e.g., interactions of operational stressors such as heat strain, psychological trauma, and pesticides) with neurotoxic chemical exposures including petroleum products and insecticides). The goals of the Health Behavior/Weight Control effort are to evaluate the effectiveness of specific health behavior interventions, modification to establish their benefit to readiness, especially non-drug, neuroprotection that comes from an informed and positive lifestyle. This project contains no duplication with any effort within the Military Departments and includes direct participation by other Services working on Army projects. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Nerve-based Disease Research: In FY06, conducted detailed neuropsychological testing to characterize behavioral and cognitive changes associated with deployment in Operation Enduring Freedom, measuring deployment, and redeployment effects in various units across the Army. This established normal deployment-related changes due to operational factors, and provides a baseline for comparison of future test results. In FY07, further characterize cognitive and behavioral changes associated with deployment, and assess the time it takes for recovery. Refine the Automated Neuropsychological Assessment Metric (ANAM) test battery to a minimum number of robust, reproducible, and well-validated set of tests, which provide measures of change in psychological and neural functioning due to military operational impacts. In FY08, will complete a study of relationships between military occupation and nerve degeneration diseases. Will complete comprehensive data collection on the health effects of exposure to jet fuel in a military setting. Plan to complete examination of individual permethrin (insect repellent) exposure and dose levels in different environmental settings designed to simulate operationally relevant scenarios. In FY09, complete analyses of the association between jet fuel exposure over a workweek and nervous system health outcomes. Will complete studies of head trauma (i.e. head impact due to poor parachute landings and boxing as models) and neuropsychological adverse effects (mood and cognitive function).	3687	6065	6313	4692
Health Behavior/Weight Control: In FY06, completed an evaluation of the Army Weight Control Program that led to a change in current regulations and standards, allowing for increased body fat standard accommodation with higher levels of fitness. The validation involved extensive laboratory-based measurements and field implementation experiments to ensure that the changes in the regulation provide	3100	2010	2150	4110

substantive improvements in management of health and fitness of the Army. This modification permits increased recruitment and retention of fully qualified performers that are not at increased risk for deployment health issues. Completed evaluation of a Personal Digital Assistant based weight management program. In FY07, develop a diet and exercise program for redeployed Soldiers to reduce body fat without loss of lean body tissue (including bone and muscle). In FY08, will assess novel military weight management programs that include food intake monitoring, meal replacement, and portion size retraining. Will complete analysis of two community based interventions programs for military weight management in active duty and reserve forces. In FY09, will characterize the benefits of scientifically based fitness programs in protecting Soldiers against near and long-term disease risks, with special emphasis on the relationship between weight management, fitness habits, and pre-diabetes health and performance consequences. Will develop and test programs to enhance physical readiness of reserve forces. Will complete collaborative study with University of California and the Army Institute for Creative Technologies, which is focused on developing new technology for training interventions to prevent health damaging behaviors, optimize personal fitness, and increase operational readiness.				
Small Business Innovative Research/Small Business Technology Transfer Programs		234		
Total	6787	8309	8463	8802

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603001A - Warfighter Advanced Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	75067	65632	47065	47055	42856	44354	45706	46730
242	AIRDROP EQUIPMENT	3696	4051	4154	3820	3860	3890	3976	4063
543	AMMUNITION LOGISTICS	1395	1295	1328	1281	1369	1378	1408	1439
C07	JOINT SERVICE COMBAT FEEDING TECH DEMO	2036	1987	1791	2264	2289	2305	2356	2408
J50	FUTURE WARRIOR TECHNOLOGY INTEGRATION	48004	32883	39792	39690	35338	36781	37966	38820
J52	WARFIGHTER ADVANCED TECHNOLOGY INITIATIVES (CA)	19936	25416						

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates technologies to enhance dismounted Soldier system capabilities while reducing the logistics burden on the battlefield; decreasing operation and sustainment costs; and improving ammunition logistics system performance. This PE contains projects that address technologies for use in the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. The major effort in the Future Warrior Technology Integration project (J50) is the Future Force Warrior (FFW) program that utilizes technology integration and multi-functionality to provide combat overmatch capabilities for the individual Soldier and small combat unit while reducing Soldier load. The program will demonstrate technologies to provide a lightweight, full spectrum protective combat ensemble, modularly integrated with multi-functional sensors, weapons, and medical monitoring capabilities. The program will also mature and integrate technologies for connectivity to other dismounted personnel, FCS, and robotic air/ground platforms for improved situational understanding and effects. The Joint Service Combat Feeding Technology project (C07) demonstrates technologies for military combat feeding systems and combat rations to include processing, preservation, packaging, and equipment and energy technologies to reduce the logistics footprint while enhancing warrior mental and physical agility. The DoD Combat Feeding Research and Engineering Board and Nutrition Committee provides oversight for this project. The Ammunition Logistics project (543) demonstrates technology that optimizes weapon system rearm, ammunition packaging/palletization, explosives safety, material handling equipment, and ammunition throughput/management for improved munitions availability and survivability. The Airdrop Equipment project (242) provides enhancements to rapid deployment and force projection capabilities by maturing and demonstrating technology required for dropping increasingly heavier cargo to precise locations from high altitudes and greater offset distances. The objective is to increase both the survivability of aircraft and crews, and the probability that payloads delivered will land in a usable condition. The major effort within this project is to demonstrate a 30,000 lb. precision airdrop capability that interfaces with the Joint-Modular Intermodal Platform (J-MIP) Joint Capability Technology Demonstration. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. The projects in this PE adhere to Tri-Service Agreements on clothing, textiles, and food with oversight and coordination provided by the directors of Service laboratories through the Warrior Systems Technology Base Executive Steering Committee. Work in this PE is related to and fully coordinated with efforts in PE 0602786A (Warfighter Technology), PE 0602105A (Materials Technology), PE 0602618A (Ballistics Technology), PE0602624A (Weapons and Munitions Technology); PE 0602705A (Electronics and Electronic Devices), PE0603004 (Weapons and Munitions Advanced Technology); PE 0603008A (Command, Control, Communications Advanced Technology), and PEs 0602623A and 0603607A (Joint Service Small Arms Program). Work is performed by the US Army Natick Soldier Center, Natick, MA; the Armament Research, Development, and Engineering Center, Picatinny, NJ; and the Research, Development, and Engineering Command, Edgewood MD.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603001A - Warfighter Advanced Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	77434	45666	48280	47989
Current BES/President's Budget (FY 2008/2009)	75067	65632	47065	47055
Total Adjustments	-2367	19966	-1215	-934
Congressional Program Reductions		-5251		
Congressional Rescissions				
Congressional Increases		25700		
Reprogrammings	-2367	-483		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1215	-934

Thirteen FY07 congressional adds totaling $24632 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($2301) Ration Packaging Material & Systems for MREs
($2875) Multifunctional Protective Packaging Technology
($1917) Small Business Dev and Transition
($1054) JPADS-Rapid Refueling of 2K lb Resupply Req
($3067) Multi-Layer Coextrusion for high Perf Pkg Film
($958) CoE for High Performance Fibers
($1869) Chemical/Biological Agent Protection
($3163) High-Pressure/Microwave Meals Ready-To-Eat Process
($1534) Monolithic Breatheable Film f/Chem/Biol Prot Cloth
($958) Mosaic Extremity Protection
($2684) NBC Integration Protection Membrane-Shelters
($958) Rapid Felding of Precision Airdrop to Iraq & Afghn
($1294) Silicon Based Micro Fuel Cell on a Chip

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603001A - Warfighter Advanced Technology**	**242**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
242 AIRDROP EQUIPMENT	3696	4051	4154	3820	3860	3890	3976	4063

A. Mission Description and Budget Item Justification: This project focuses on the maturation and demonstration of equipment and innovative techniques for aerial delivery of cargo and personnel. This is a key capability for rapid force projection and global precision delivery envisioned for the Future Force. Precision airdrop can provide a long-range, autonomous airdrop capability, with the option to deliver separate and distinctive payloads to multiple locations. Capitalizing on advances in decelerators, guidance, and sensing (e.g., Global Positioning System), and wind sensing technologies, precision airdrop systems have the ability to be deployed from high altitudes (up to 25,000 ft) with large offset distances (between 8 and 20 kms) and to deliver payloads with improved accuracy, which enhances cargo, crew, and aircraft survivability. This project provides technology development for the family of Joint Precision Airdrop Systems which will demonstrate a precision delivery capability with 100 meter Circular Error Probable (CEP) accuracy for systems 2000 lbs or smaller. A second major effort to increase the payload weight to 30,000 lb began in FY04. The efforts in this project support the Army Transformation goals in the area of rapid deployment. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. Work in this project is performed and managed by the US Army Natick Soldier Center, Natick, MA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Medium Precision Airdrop (capability for payloads up to 30,000 lb): In FY06, performed component and Guidance, Navigation and Control (GN&C) evaluations; began full-scale system design; completed component level modeling and began system modeling; completed evaluation of advanced textile materials; and integrated intermodal platform. In FY07, complete all component-level evaluations, system design, and system modeling; integrate components into airdrop system; and begin system evaluation and system control logic validation. In FY08, will demonstrate full-scale concept for guided, autonomous, precision medium (30,000 lbs) airdrop of Future Force payload.	3696	3952	4154	
Advanced Precision Airdrop Enhancements: In FY09, will leverage airdrop technologies developed for the 30,000 lb Medium Precision Airdrop System to develop a 42,000 lb precision airdrop capability that utilizes latest GN&C technology. A 42,000 lb capability is needed to airdrop vehicles within the family of Future Force vehicles. Will optimize and demonstrate GN&C technology enhancement for precision airdrop. Will spiral the second generation GN&C technology into Joint Precision Airdrop System (JPADS) family.				3820
Small Business Innovative Research/Small Business Technology Transfer Programs		99		
Total	3696	4051	4154	3820

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603001A - Warfighter Advanced Technology**	**543**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
543 AMMUNITION LOGISTICS	1395	1295	1328	1281	1369	1378	1408	1439

A. Mission Description and Budget Item Justification: This project develops technology that provides rapid munitions deployability, resupply, and return from deployment for the Army's Future Force. It enhances force readiness and reduces the logistics footprint through improvements in explosive safety, Materials Handling Equipment (MHE), ammunition and missile packaging/palletization, and asset throughput/management. It also improves weapon system rearm for artillery, armor, air defense, aviation, and infantry. A major effort is a lightweight, high strength cargo platform system, the Joint Modular Intermodal Platform (JMIP), which is a key component of the JMIP Joint Capability Technology Demonstration (JCTD) and leverages work funded in Defense-wide PE 0603750D. The effort facilitates logistics through its compatibility with the Theater Support Vessel; C-17 and C-130 aircraft; current and future trucks; and aerial delivery systems. The JMIP's modularity and compatibility will reduce aircraft load/unload time by up to 75 percent, and allow more efficient loading of aircraft (reducing number of aircraft missions required). Technology will transition to weapons and munitions development programs for weapons, munitions, MHE, and tactical vehicles. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. This project is managed by the US Army Armament Research, Development, and Engineering Center, Picatinny Arsenal, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Component of the Joint Modular Intermodal Distribution System (JMIDS) Joint Capability Technology Demonstration (JCTD): In FY06, completed design, fabricated prototypes, and conducted engineering testing of a Joint Modular Intermodal Platform (JMIP) as part of an integrated set of technologies (JMIP, the Joint Modular Intermodal Container (JMIC), and an Automatic Identification Technology (AIT) tag) that facilitated the efficient, rapid, and continuously visible movement and handling of supplies across all transportation modes through the Defense Transportation System and on to forward combat forces. In FY07, modify design, and test demonstration quantities of JMIPs with integrated AIT. Conduct Limited Military Utility Assessments (LMUA) and a full-scale MUA as part of the JCTD. In FY08, will conduct residual evaluation of JMIDS with field users as part of the JCTD. Will demonstrate a generic interface tool on MEMS Inertial Measuring Unit (IMU) and Active Coating Technology (ACT) which integrates physics, reliability, and cost optimization models in order to provide a reliability prediction, assessment, and design-in trade-off capability never previously available. In FY09, will conduct integration of tool-specific and generic software interfaces. Will integrate uncertainty quantification and probabilistic risk assessment functionality into the generic interface tool and demonstrate with MEMS IMU and ACT. Will perform aging studies of MEMS IMU/ACT components to update models.	1395	1265	1328	1281
Small Business Innovative Research/Small Business Technology Transfer Programs		30		
Total	1395	1295	1328	1281

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603001A - Warfighter Advanced Technology**	**C07**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
C07	JOINT SERVICE COMBAT FEEDING TECH DEMO	2036	1987	1791	2264	2289	2305	2356	2408

A. Mission Description and Budget Item Justification: This project matures and demonstrates nutritionally advanced rations; biosensor technologies for ration contamination/ wholesomeness assessment; and logistically streamlined combat feeding systems with enhanced fuel efficiencies to decrease the combat feeding logistics tail. The project is a Department of Defense (DoD) program for which the Army has Executive Agent responsibility. The project provides technology development for the family of Joint Service Combat Feeding which will demonstrate advances in combat ration technology, materials, energy utilization, and heating technologies to provide efficient and effective field feeding with reduced resupply burden. It exploits advances in ration formulation and quality, packaging, preservation, and nutritional content to improve morale, extend endurance, and sharpen mental acuity. It also demonstrates predictive modeling and simulation to assist in ration design, mission, planning, and Class I (subsistence) distribution and tracking. This project supports the Army Transformation with a goal to demonstrate combat feeding technology with potential to reduce logistics (in component parts, weight, cube, fuel, and water) and labor requirements, while improving the quality of food service. The work in this project is performed and managed by the US Army Natick Soldier Center, Natick, MA, with oversight from the DoD Combat Feeding Research and Engineering Board. This project has collaborative efforts with the US Army Research Institute for Environmental Medicine. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Equipment and Energy Technologies: In FY06, demonstrated and transitioned thermoelectric water heater chiller to Program Manager Force Sustainment Systems (PM FSS). Demonstrated Capillary Force Vaporizer (vaporizer with no moving parts and constructed of layered ceramics) stove and associated equipment, and transitioned to PM Clothing and Individual Equipment (PM CIE), and PM-Individual Combat Equipment (PM ICE). Demonstrated improved cookware with an applied quasicrystal, nonstick durable coating with superb tribological properties substantially reducing sanitation water requirements. In FY07, demonstrate and transition thermoelectric self-powered tray ration heater for Army, US Marine Corps, and Air Force kitchens reducing reliance on JP8 by about 50 percent; complete and transition procurement specs for quasicrystal nonstick durable coating. In FY08, will integrate and demonstrate a prototype beverage chiller with a standard hydration bladder and transition to PM CIE and PM ICE; will develop Joint Service Mobile Kitchen Trailer upgrade; will demonstrate Multi-serving Self-Heating Hot Water System enhancement to Unitized Group Ration Express (UGR-E); will conduct final technology demonstrations of the Mobile Integrated Sustainable Energy Recovery (MISER) system and transition to PM FSS; will complete prototype development and demonstration of Solar-powered Refrigerated Container and transition to PM FSS. In FY09, will complete demonstrations of Joint Service Mobile Kitchen Trailer upgrade based on state of the art power generation systems and transition to PM FSS; will complete technology demonstration of an air-activated self-contained exothermic chemical ration heater and transition to PM FSS.	269	246	645	581
Ration Stabilization, Packaging, and Novel Nutrient Delivery Technologies: In FY06, completed evaluation of array diagnostic biosensor systems and validated for two of the top four food pathogens identified by the Veterinary Services Activity and Office of the Surgeon General. Evaluated and down selected commercial container security devices for a technical demonstration of tamper evident technology.	1767	1732	1146	1683

Analyzed and presented CENTCOM AOR storage temperature data to DLA and the Services to be used in models for developing automated tracking technology for Class I. Developed model for designing rations to contain optimal levels of macronutrients. In FY07, validate novel diagnostic technologies and demonstrate feasibility/utility of incorporation into array systems for the rapid detection of food pathogens. Conduct producibility and performance testing of MRE meal bags fabricated from a low density polyethylene nanocomposite to significantly reduce weight and cube of individual ration packaging. In FY08, will downselect novel diagnostic technologies for incorporation into advanced array systems which expand diagnostic capability, while reducing weight and cube of deployable system. Will conduct biodegradable water and insect repellent coating trials for commercial fiberboard secondary ration packaging to reduce cost and enhance recycling capability. In FY09, will demonstrate effectiveness of providing performance enhancers via buccal delivery (directly into bloodstream through tissue in mouth); will conduct final technology demonstration of novel diagnostic technologies incorporated into array systems for food pathogen detection and will transition to Veterinary Services Activity and Office of the Surgeon General for procurement. Will incorporate performance enhancers into ration components to achieve a 20 percent demonstrated improvement in one or more highly relevant military perforperformance tasks (e.g., victim rescue, 30m combat rushes).				
Small Business Innovative Research/Small Business Technology Transfer Programs		9		
Total	2036	1987	1791	2264

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603001A - Warfighter Advanced Technology**	**J50**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J50	FUTURE WARRIOR TECHNOLOGY INTEGRATION	48004	32883	39792	39690	35338	36781	37966	38820

A. Mission Description and Budget Item Justification: This project leverages, matures, and integrates high-payoff technologies for transition to Soldier acquisition programs and directly supports the Army Training and Doctrine Command's (TRADOC) Ground Soldier System (GSS), AROC approved; JROC approval scheduled for Apr 07. Capability Development Document (CDD) and Soldier as a System (SaaS) concept. The major effort in FY06 and FY07 is the completion of Future Force Warrior (FFW) System of Systems (SoS) ATD which addresses TRADOC's GSS requirements. The FFW program is maturing and demonstrating technologies which provide dismounted warfighters in the Small Combat Unit (SCU) with enhanced capability in the areas of survivability, networked communications/collaborative situational awareness, lethality/cooperative engagement, and agility while enabling extended combat missions with reduced loss in physical capabilities from fatigue, stress, and hardship. The FFW SoS utilizes open system architectures to provide a lightweight system-engineered, integrated modular protective combat ensemble employing plug and play components such as multi-function sensors, networked communications, enhanced positioning navigation, networked targeting and fire control, embedded training, medical status monitoring, and connectivity with air and ground sensors and platforms. This FFW SoS provides connectivity to other dismounted personnel and Current/Future Force platforms to form adaptive, distributed networks for better situational understanding of local environments and threats. Demonstrations include FY06 participation in the C4ISR On The Move (OTM) and Air Assault Expeditionary Force (AAEF) Spiral C experiments, and FY07 participation in FCS Exp 1.1, C4ISR OTM and AAEF Spiral D experiments. Key performance goals are to demonstrate a Soldier borne system with fighting load of no more than 70 lbs for the rifleman; the ability to operate for 24 hrs autonomously at the individual level and 72 hrs at the brigade combat team (BCT) level; integration of the Soldier Radio Waveform (SRW) with digital networking Soldier radios; and interoperability with Future Systems. The FFW program works closely with the Army's Squad Level Integrated Communications Environment (SLICE (developing SRW)) programs, as well as other Army S&T, Air Force Research Lab (AFRL), and other DoD programs to maximize return on investment to the Army. Further, since many of the components/subsystems can be further engineered and fielded independently, this project is working directly with PEO Soldier to identify and transition early maturing technologies into ongoing PEO Soldier acquisition programs. The longer-term effort (FY08 and beyond) is to exploit the Soldier system and component technology architecture developed in FFW to support ongoing and future Soldier acquisition programs with specific emphasis on the following capability improvements: advanced and integrated lightweight Soldier protection and mobility; Soldier-borne computing, communications (including Joint Tactical Radio System (JTRS)) and subsystem networking; Soldier displays, Situational Awareness (SA) and Input/Output (I/O) devices; and lightweight high energy-density Soldier power including disposable and rechargeable batteries, fuel cells, and small engines. This project provides flexibility to support capability growth for any Soldier system architecture going forward. The cited work in this project is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. Through FY07, the project integrates and matures Soldier technologies transitioned from program elements (PEs) 0602786A, 0602105A, 0602308A, 0602623A, 0602705A, 0602782A, 0603008A, and 0603607A to FFW SoS. Through FY08 and FY09 revolutionary advances in key technology areas and capabilities will be developed for ground and mounted Soldiers and aviators up to the small unit level and validated through enabling technical, modeling, and operational testing and evaluation. The results of these efforts will be transitioned to PEO programs relevant to the capability developed. The US Army Natick Soldier Center, Natick, MA, manages this project

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
FFW Body Borne System: Activities are focused on technology integration in a lightweight, low power, ergonomically designed,	5904	3326		

integrated modular package to meet overall 70 lb weight threshold (rifleman) and 24 hr autonomous mission. Included are systems engineering tasks to include development of architecture, metrics, requirements refinement, and allocation to subsystems, interoperability, and supportability. In FY06, completed design and development of Soldier-borne hardware architecture for SCU configurations. Integrated hardware subsystems into the FFW Soldier Protection and Individual Equipment System (SPIES), including: integrated stand off ballistic protection and load carriage chassis; signature management; semi-permeable membrane (chemical-biological protective) over-garment; laser detectors for Tactical Engagement System (TES); body worn antennas; power sources; communications; laptop computer; position/navigation; fire control; Warfighter Physiological Status Monitoring (WPSM)-Initial Capability; and Personal Area Network (PAN). Developed interface(s) to share Situational Awareness/Common Operating Picture from higher echelons and to ensure size/cube compatibility for ground vehicle Soldier compartments. Fabricated and tested 12 integrated body borne systems. Developed engineering projections and fabricated one leader and one Basic Soldier mockup. In FY07, complete final system development and integration and, integration of PAN enhancements. Retrofit existing 12 systems and fabricate and test 35 additional integrated body borne systems to support up to platoon level size field demonstrations. This task leverages and integrates technologies developed in PE602786A.				
FFW Headgear: In FY06, completed design and development of basic helmet configuration integrating leveraged lightweight ballistic shell and liner materials. Completed development of modular add-on hardware for leader/MOS specific capabilities, including initial implementation of TES/laser sensors, microphone, visual, and infrared dual aperture sensor fusion and integrated high resolution color helmet mounted display and communication system integration. Performed systems engineering tasks to refine architecture, metrics, and requirements allocation in order to identify the size, weight, and power requirements of the headgear. Developed backwards-compatible interfaces for fielded Advanced Combat Helmet (ACH). Completed exploration of active noise reduction for FFW. Initiated integration of AFRL headgear components, including Air Force Special Operations Command (AFSOC) Battlefield Air Operations (BAO) Kit. Fabricated, integrated, and tested 12 headgear systems using surrogate ballistic materials. Conducted ballistic testing on headgear materials, both flat plate and FFW formed helmet shape. In FY07, complete integration of headgear ballistic material, FFW single aperture vision enhancement, sensor fusion, TES functionality, XM50 chem/bio mask interface, and AFSOC BAO Kit. Modify existing 12 systems and fabricate, integrate and test 25 additional headgear systems to support field demonstrations. Perform systems engineering tasks to support integration, interoperability, and supportability. This task leverages and integrates technologies developed in PE 602786A and PE602105A.	11490	5591		
FFW Soldier Computer/Software (SW): In FY06, executed incremental development of Soldier computer (leveraged LW). Integrated AFRL Cursor on Target(CoT), FalconView and Barebones software packages (FFW modified cooperative engagement/targeting SW leveraged from AFRL "BareBack" SW kit) for alternative computer/SW solution and broader connectivity to Army/joint combat firepower. Continued SW development/testing of Operating System and info/power management, WPSM interface, netted fires/cooperative engagement, embedded training (memory joggers, TES), SA, mapping image capture/transmittal, user interfaces, System Voice Control, and Unmanned Aerial Vehicle (UAV) data feed. Developed SRW based Application Programming Interface compatible w/future digital networking radios to integrate Soldier into Future Force/Joint network. Developed basic compatibility Common Operating Environment, Battle Command/Network Mgmt Services, Army Battle Command System and joint Service platforms. Integrated technologies leveraged from CERDEC Command and Control Mobile Intelligent Net-centric Computer System (C2MINCS) and AFRL (CoT, FalconView and Bareback/Barebones) into SPIES. Tested FFW system w/leveraged LW computers and initial SW apps. Evaluated Army/FCS info assurance (IA)/cross domain security developments for future GSS incorporation. Modified WPSM data processing algorithms to reduce signal artifacts and improve data quality for augmented cognition. In FY07, down-select and complete computer/SW functionality development; include applications stated above and additional AAR, Built In Test, used to check/verify system performance when system is booted up, and code optimization for a power constrained computing environment. Conduct field	9898	4913		

demonstrations with FFW computer HW/SW. Closely monitor/participate in Army activities concerning IA and Multiple Level Security. Perform system engineering to support integration/interoperability/supportability. Task leverages/integrates PE602308A.				
FFW Personal Area Network (PAN): In FY06, developed PAN components for distribution of power and data across the FFW electronic components, leveraging both LW cables/connectors and novel electronic textile cables. Performed systems engineering to refine architecture, metrics, requirements allocation, and interface controls. In FY07, refine PAN, and fabricate, and test PAN to support field demonstrations. Perform systems engineering tasks to support integration, interoperability, and supportability.	1019	705		
FFW Power Sources: In FY06, continued development and evaluation of rechargeable prismatic Lithium Polymer cells. Defined new packaging design for batteries that is ergonomic and takes less space. Continued development and evaluation of next generation Zinc-air disposable battery for use as a mission extender (for missions beyond 24 hrs) and as part of a hybrid system. Evaluated hybrid system performance against a hypothetical power profile that simulates MOUT mission. Procured for assessment and evaluation, prototype 20-watt direct methanol fuel cell system. Measured energy consumption/battery run-time by duty position during C4ISR OTM demonstration. In FY07, conduct analyses on energy usage from FY06 FFW demonstrations. Procure, test, and integrate direct and reformed methanol fuel cells for FY07 FFW demonstrations. This task leverages and integrates technologies developed in PE602705A.	1005	813		
FFW Network/Communications/ Antennas: In FY06, developed communications and SCU network interface Hardware/Software (HW/SW) functionality leveraging Soldier Radio Waveform (SRW) and developed backwards compatibility to Current Force. Implemented FFW communications architecture for the SCU and integrated it with the SLICE SRW-based network. Conducted network modeling and simulation. Developed network gateway for Soldier connectivity to unmanned ground systems, UAVs, and legacy systems. Optimized communications architecture for compatibility with FCS and joint platform assets while ensuring robust peer-to-peer communications, situational awareness, and synchronization of fires while away from supporting platforms. Developed hardware interface for leveraged handheld radios. Integrated and evaluated advanced body mounted antennae concepts to support robust communications in restricted positions and environments. Fabricated and integrated components for 12 systems to support FY06 demonstrations. In FY07, refine network based on FY06 demonstrations and M&S. Fabricate 25 additional communication subsystems to support field demonstrations. Perform systems engineering tasks to support integration, interoperability, and supportability. This task leverages and integrates technologies developed in PE 602782A and 603008A.	5766	2671		
FFW Small Combat Unit (SCU) Lethality and Fire Control: In FY06, developed distribution of lethality capabilities across the SCU. Completed modification of XM104 prototype fire control systems for day/night non-line-of-sight cooperative engagement and integrated with LW weapon user interface and FFW body borne system. Conducted parallel risk reduction cooperative engagement effort integrating AFRL CoT, BAO Kit, and Barebones, an application which autopopulates targeting data, and integrating Command and Control Mobile Intelligent Net-centric Computer System (C2MINCS) from CERDEC into FFW system to enable seamless connectivity between Soldiers and Army/USAF/joint platforms. Developed XM104 hardware interfaces including black box, Weapon User Interface (WUI), and interfaces to Soldier Computer and integrated visible aiming laser and pointer/illuminator. Conducted laboratory demos and live fire assessments of modified XM104. Integrated FFW system with Multi-function Laser/ Small Tactical Optical Rifle Mounted Micro-Laser Range Finding System, Medium Thermal Weapon Sight, and Daylight Video Sight for long range target acquisition. Procured government-furnished equipment (GFE) lethality components to support FY06 demonstrations. In FY07, downselect optimal SCU lethality/fire control solution and complete development and integration into FFW SoS. Fabricate distributed lethality components to support field demonstrations. Perform systems engineering tasks to support integration, interoperability, and supportability. This task leverages and integrates technologies developed in PE 602623A and PE 603607A.	2166	1098		
FFW Precision Position System (PPS): In FY06, initiated development of a high fidelity personal navigation system utilizing Micro	3418	2365		

Electro-Mechanical System Inertial Measurement Unit technology leveraged from DARPA/Draper Labs. This effort provides improved accuracy (3 m vs. 10+ m) necessary to enable precision netted lethality/fire control capabilities and 3-D position location in Global Positioning System denied areas (e.g. inside buildings), while reducing system size, weight and power. Initiated fabrication of 5 PPS systems and PPS power management study. In FY07, integrate precision position/navigation system into overall FFW architecture. Complete development of PPS systems and conduct integration into FFW HW/SW architecture to support field demonstrations. Perform systems engineering tasks to include metrics, requirements allocation, interoperability and supportability.				
FFW Technical Evaluations, Analysis, Assessments and Demonstrations: In FY06, conducted technical evaluations in a Soldier Integration Lab environment, and conducted modeling and simulation evaluations/assessments to validate component/subsystem performance, integration, and "what if" analyses to explore system robustness. Conducted SCU combat effectiveness and cost benefit analyses comparing FFW capability enhancements against currently fielded Soldier equipment and Land Warrior (LW) baseline capability sets to identify extent of performance improvements. Initiated planning for C4ISR OTM and AAEF demonstrations. Remaining FY06 activities included development of Tactics, Techniques, and Procedures for SCU tactical employment of FFW capabilities and associated training program for AAEF demonstrations. Conducted FFW system level demonstrations and evaluation through participation in C4ISR OTM and AAEF Spiral C demonstrations to validate EXFOR training, system performance progress, and network interoperability. FY06 C4ISR OTM demonstrations included an EXFOR excursion to assess performance of integrated FFW/CERDEC/AFRL technologies. Based on results of C4ISR OTM, downselected optimal solution set for final development and integration for FY07 demonstrations. In FY07, conduct EXFOR training and execute FFW System level demonstrations through participation in FCS Exp 1.1, C4ISR OTM and AAEF Spiral D demonstrations employing an FFW equipped platoon to validate system performance at Technical Readiness Level 6. Complete final analyses regarding SCU combat effectiveness. Initiate trade studies to identify optimal technology solutions and integration opportunities for FY08 investment after completion of the FFW ATD.	7338	6526		
Soldier Ballistic and Blast Protection: In FY08, will design innovative ballistic and blast protection solutions for ground and mounted Soldiers and aviators to defeat or provide increased protection against evolving bullet, fragmentation, and blast threats. Will explore innovative, multiple-impact survivability concepts for the torso and significantly improved protection for head, face, and extremity threats based on the FFW physical architecture, which integrates weight reduction, anthropometry, modularity, and tactical gear packaging to increase Soldier mobility and reduced stress in hot and cold extremes. Will mature technologies and concepts for advanced fibers, polymers, ceramics, nano and/or composite materials that increase ballistic and blast protection; passive, active, and hybrid thermal management technologies, semi-permeable membranes, and moisture wicking and other fabric/membrane technologies that improve temperature management. Concepts and materials technologies for ballistic armor and blast protection will be leveraged from PE 602786A and PE 602105A. In FY09, will continue Soldier ballistic and blast protection technology maturation and integration efforts. Will conduct technical tests and field demonstrations, combined with user feedback to ensure relevant system performance evaluations that enable rapid transition of integrated technology solutions to Soldier acquisition programs.			5500	5000
Integrated Soldier Protection: In FY08, will design innovative, integrated protection and health monitoring solutions for ground and mounted Soldiers and aviators in the areas of improved tactical concealment; protection against flame, lasers, and toxic industrial chemicals and materials (TIC/TIM); multi-spectral signature reduction; physiological monitoring for near-real-time Soldier health status enabling pre-emptive, accurate, and timely triage and treatment, and integrated protection concepts incorporating active ventilation and micro-climate cooling with combat headgear-integrated respiratory and ocular protection. Will mature concepts and material technologies leveraged from PE 602786A and PE 602105A for integrated protection that include: selectively permeable membranes; flame resistant fibers, fabrics and treatments, nano-technology based materials; cooling, ventilation, and filtration technologies optimized for weight and power reduction; and physiological sensors and algorithms. Integrated chemical, biological, TIC/TIM protection solutions will be			5500	6050

developed in collaboration with Joint Science and Technology Offices Joint Chemical Ensemble project. In FY09, will select the most promising technologies from integrated protection and health monitoring solutions designed in FY08 and continue to mature for transition to appropriate PEO programs. Will focus efforts on the needs of both the individual warfighter and on small unit capabilities for ground and mounted Soldiers and aviators. Technology maturation will be enabled by modeling and analysis to evaluate impacts on combat effectiveness at the individual and small unit levels. Will conduct technical tests and structured and freeplay field demonstrations to obtain relevant user feedback to ensure technical and operationally-based system performance metrics are met and to support rapid transition of integrated technology solutions to Soldier acquisition programs.				
Soldier Mobility and Enhanced Load Carriage: In FY08, will design/integrate innovative Soldier mobility and load carriage solutions and mature technologies for ground and mounted Soldiers and aviators to include exoskeleton, lower extremity load carriage devices, and advanced materials for load carriage applications that reduce system size, weight and metabolic energy costs and enhance mobility while optimizing Soldier fighting and sustainment loads. Will leverage, integrate and mature technology concepts for Soldier mobility and load carriage, including: concepts developed under PE 602786; the DARPA Exoskeleton programs; Army biomechanical tools for maximizing Soldier load carriage capability; Lower Extremity SBIR and the Institute of Soldier Nanotechnology's (ISN) lightweight nano-materials for lightening the Soldier's load and demonstrating non-tethered, integrated-power exoskeleton devices for the upper and lower body extremities. In FY09, will continue to mature technology and integrate Soldier load carriage and mobility systems. Will conduct technical tests and field demonstrations, combined with user feedback to ensure relevant system performance evaluations that enable rapid transition of integrated technology solutions to Soldier acquisition programs.			3750	3500
Soldier Network Integration: In FY08, will integrate and mature innovative, cost-effective, durable, smaller, lighter, more power efficient Soldier and Small Combat Unit (SCU) networking technologies with Soldier information awareness technologies and systems and emerging tactical networks for ground and mounted Soldiers and aviators. The goal is to maintain compatibility and interoperability of unique platoon, squad, and individual Soldier information requirements with company and higher Command and Control (C2), and Situational Awareness (SA) infrastructures. This includes accurate and timely role-based tactical information delivery, information assurance and bio-metrics supporting simultaneous classified and unclassified network interoperability, and human/machine interface device technologies that allow the Soldier to tailor the manner in which information is presented. Will leverage, integrate and mature technology solutions including see-through/ flexible displays, heads-up/heads-down displays, small form-factor processors, advanced communication headsets with ear protection. This includes devices such as motion-sensing gloves, integrated trackball/mouse and keypads; reliable jam-proof wireless technologies and advanced cabling and connectors to include e-textiles and micro/nano connectors to enhance personal area networking between head, body, and weapon systems. This task leverages, matures and integrates technology developed in PE 602705A and flexible display work. In FY09, will continue to mature Soldier, squad, and platoon network technology integration efforts. Will conduct technical tests and field demonstrations, combined with user feedback to ensure relevant system performance evaluations that enable rapid transition of integrated technology solutions to Soldier acquisition programs.			8150	8450
Soldier Power and Energy: In FY07, evaluate hybrid power systems for reliability, suitability, and utility on Soldiers, leveraging test results and knowledge developed in PE0602705A and from feedback gained from lab and field demonstrations. Collect data during field demonstrations that capture duty cycles and load profiles by duty position and mission scenarios for use in refining Soldier system architectures and power source system optimization. Mature conformal rechargeable battery concept and demonstrate completed battery packs on a bench-top. Monitor and track developments in solid oxide fuel cells as well as thin-film rechargeable battery technology. Evaluate various candidate technologies for use as platoon-level generators including engines and fuel cells. In FY08, will integrate innovative Soldier power and energy solutions and mature system solutions for ground and mounted Soldiers and aviators to include a methanol-based Soldier hybrid fuel cell power source developed under PE 0602705A; conformal rechargeable battery packs integrated		4000	5025	5012

into Soldier tactical gear; solid oxide fuel cells and thin-film rechargeable batteries and platoon-level battery recharging generator. In FY09, will continue to mature and integrate Soldier-level solid oxide fuel cell power source and leverage Soldier hybrid system technologies developed in PE0602705A. Will initiate rechargeable battery development based on packaging thin film rechargeable battery technology. Will integrate nano-technology based electro-textiles with photovoltaic energy properties to augment primary system power sources. Will demonstrate JP8-fueled platoon-level generator recharging batteries. Will conduct technical tests and field demonstrations, combined with user feedback to ensure relevant system performance evaluations that enable rapid transition of integrated technology solutions to Soldier acquisition programs.				
Small Unit Lethality Integration: In FY08, will conduct lethality and affordability analyses of Small Combat Unit (SCU) operational concepts and enabling technologies and evaluate promising technologies individually and as an integrated systems of systems as appropriate. Will analyze effectiveness (using models and simulations to assess the combat effectiveness of the small combat unit) of networked lethality; small-unit weapon systems; weapon-based sensors, optics and fire control; breeching kits; lethal and non-lethal effects; armored vehicle destruction; fighting in urban and complex environments; innovative message processing that reduces time, increases accuracy and safety, and coordinates identification, targeting, synchronization, and massing of internal and external Platoon fires (e.g. Field Artillery and Army/Joint Aviation). Will assess design parameters impacting the SCU to include: system size, weight, power, and cost; precision of direct and indirect fires; weapon system range; ability to reduce operational cycle from detection to destruction in order to identify cost/performance trade space. Will integrate enhancements to small unit cooperative engagement for more accurate firing solutions to include integration with XM-320 grenade launcher and improved firing solution software (updated ballistics tables) for both the XM-104 and Picatinney Smart Sight. In FY09, will continue to evaluate common net-centric SOSCOE compliant Fire Control, target effects decision support component technology from PE 602623, Joint Service Small Arms Program. Will continue small unit lethality technology integration and maturation efforts. Will conduct technical tests and field demonstrations, combined with user feedback to ensure relevant system performance evaluations that enable rapid transition of integrated technology solutions to Soldier acquisition programs.			4900	5106
Small Unit Systems Integration and Demonstration: In FY08, will expand the Natick Soldier Center Systems Integration Lab (SIL) capabilities to include an open architecture lab environment, coupled with a robust data collection infrastructure to support early and iterative analysis of emerging Government, Industry, Soldier and Small Combat Unit (SCU) technology integration, interface, and operational issues. Will continue to identify means to improve support for the Soldier and Small Combat Unit physical, network, software, interoperability, and human integration testing within a system of systems platform without impacting concurrent technology innovation. Will integrate performance evaluation and assessment of survivability, lethality, and power and energy technologies seamlessly within current and emerging small unit operational and technical architectures; evaluate rapidly configured and reconfigured modular operational concepts, network architectures, and C2 information systems through modeling and simulation. In FY09, will develop and deploy transportable test and demonstration packages featuring pre-tested architectures, data collection infrastructure/plans/analysis with efforts conducted through simulation, design, demonstration, and test in both laboratory and operational scenarios, such as FCS Experiment 2.1 and Joint Forces Experiment (JFEX). Will continue to perform Soldier and small unit systems integration activities in the SIL, plan and execute system demonstrations and participate in RDECOM- and TRADOC-sponsored assessment events and evaluations. Capture outputs from demonstrations, reduce and analyze the data and prepare assessment of small unit combat effectiveness.			6967	6572
Small Business Innovative Research/Small Business Technology Transfer Programs		875		
Total	48004	32883	39792	39690

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603002A - MEDICAL ADVANCED TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	293791	299017	53274	54863	53083	53353	54573	55694
800	TELEMEDICINE TESTBED	2931	3818	5425	4118	3994	4080	4170	4261
801	DEF WOMEN'S HEALTH RES	1438	1780						
804	PROSTATE CANCER RSCH	1916							
810	IND BASE ID VACC&DRUG	16844	21003	21368	22206	20703	20632	21131	21518
814	NEUROFIBROMATOSIS	16294	9889						
819	FLD MED PROT/HUM PERF	988	1159	1202	1265	1235	1267	1295	1323
840	COMBAT INJURY MGMT	16555	22259	23280	25190	25142	25324	25882	26451
893	TISSUE REPLACEMENT	4409							
923	PROSTATE DIAGNOSTIC IMAGE	2684	1186						
929	ARTIFICIAL LUNG TECHNOLOGY	1725	989						
932	Minimally Invasive Surgery (CA)	1054							
938	Tissue Engineering	959							
941	Diabetes Research	4120	2274						
945	BREAST CANCER STAMP PROCEEDS	1915							
954	DIGITAL X-RAY	959							
955	ASSISTIVE TECHNOLOGY	2492	2176						
969	ALCOHOLISM RESEARCH	5368	5439						
97A	BIOSENSOR RESEARCH	959	1879						
97B	BLOOD SAFETY	3449	989						
97D	CENTER FOR AGING EYE	1916	1977						
97O	LUNG CANCER RESEARCH	6421							
97T	NEUROTOXIN EXPOSURE TREATMENT	22045	26208						
97W	SEATREAT CANCER TECHNOLOGY		1582						
97X	SYNCHROTRON-BASED SCANNING RESEARCH	8146	5736						
FH4	FORCE HEALTH PROTECTION - ADV	1580	1959	1999	2084	2009	2050	2095	2141

	TECH DEV								
MB1	ADV DIAGNOSTICS & THERAPEUTIC DIG TECH	959	1582						
MB2	BRAIN, BIOLOGY, AND MACHINE	1916	2473						
MB3	CENTER FOR INTEGRATION OF MEDICINE & INNOV TECH	10543	9494						
MB4	CENTER FOR UNTETHERED HEALTHCARE	959	989						
MB9	JOINT US NORWEGIAN TELEMEDICINE	959	1286						
MC4	SECURE TELEMEDICINE TECH PROGRAM	1916	1286						
MC7	NATIONAL TISSUE ENGINEERING CENTER	1677							
MD1	EMERGENCY TELEMED RESPONSE & ADV TECH	1916	3214						
ME9	BEHAVIORAL/COMPARATIVE GENOMICS	959							
MF2	ADVANCED PROTEOMICS (CA)	1438	1335						
MF9	GENOMIC MEDICINE AND GENE THERAPY (CA)	2108	1780						
MG1	GYNECOLOGIC DISEASE PROGRAM (CA)	3258	3560						
MG3	MEDICAL TRAINING TECH ENHANCEMENT INITIATIVE (CA)	1054	1286						
MG5	NATIONAL FUNCTIONAL GENOMICS CENTER (CA)	4791	8901						
MG7	ON-LINE MEDICAL TRAINING (CA)	2013							
MH1	PICTURE ARCHIVING AND COMMUNICATIONS SYSTEM (CA)	1630							
MH2	PROJECT COLLABORATION MATERIAL (CA)	959							
MH3	PROTEOMICS CENTER (CA)	2492	1385						

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MH4	RAPID BIO-PATHOGEN DETECTION TECHNOLOGY (CA)	959	989						
MH6	RUGGED TEXTILE ELECTRONIC GARMENTS (CA)	1054							
MH7	STUDY OF HUMAN OPERATOR PERFORMANCE (CA)	1438							
MH9	ADVANCE OF NON-INVASIVE GLUCOSE MONITORING (CA)	1630	1434						
MI3	ADVANCES IN BREAST CANCER CARE THERAPY (CA)	1630							
MI4	ALLIANCE FOR NANOHEALTH (CA)	2013	1088						
MI5	BEHAVIORAL GENOMICS SLEEP APNEA RESEARCH (CA)	959							
MI8	FULL-FEATURED PATIENT MONITOR WITH DEFIBRILLATOR	959							
MJ1	EXTRA CORPOREAL MEMBRANE OXYGENATION AT TRIPLER		1582						
MJ2	FIBRINOGEN BANDAGES FOR BATTLEFIELD WOUNDS (CA)	2396	1780						
MJ3	FORT DETRICK TECHNOLOGY TRANSFER INITIATIVE (CA)		1483						
MJ4	HANDS FREE ELECTRONIC HEALTH RECORD (CA)	959							
MJ7	LIGHT-BASED SELF TREATMENT FOR PFB (CA)	959							
MK1	MEDICAL M&S THROUGH SYNTHETIC DIGITAL GENES (CA)	959	1088						
MK2	METROPLEX COMPREHENSIVE MEDICAL IMAGING RESEARCH	6710							
MK6	ORPHAN DISEASE DRUG DISCOVERY	1630							

	PROGRAM (CA)								
MK7	PEDIATRIC BRAIN TUMOR & NEUROLOGICAL DISEASE PRGM	1438	1186						
MK8	PLASMA STERILIZER (CA)	1438							
ML2	SEAmed ORAL HEALTH PROJECT (CA)	480							
ML3	SOLDIER-MOUNTED EYE-TRACKING & CONTROL SYSTEM (CA)	2396	1632						
ML5	SURGICAL WOUND DISINFECTION & BIO AGENT DECON PROJ	1916	989						
ML6	Tripler Army Medical Ctr eICU Remote Critical Care	959							
ML7	UNIVERSAL MEDICAL AND SURGICAL PRODUCT CATALOG(CA)	2684	2274						
MM1	WEIGHT MEASUREMENTS & STANDARDS FOR MIL PERSONNEL	1677	989						
MM2	MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)	87834	131630						

A. Mission Description and Budget Item Justification: This program element (PE) supports development of advanced medical technologies to sustain a force of healthy, medically protected warfighters. The primary goal is to mature medical knowledge and technology (drugs, vaccines, and devices) to effectively protect and improve the survivability of U.S. Forces across the entire spectrum of military operations. Efforts are focused in three principal medical areas: Militarily Relevant Infectious Diseases, Combat Casualty Care, and Military Operational Medicine. Activities funded in this PE are externally peer reviewed and, to prevent unnecessary duplication, fully coordinated with other Services and Agencies.

During this phase of development, promising medical technologies are refined and validated through extensive testing, which is closely monitored by the U.S. Food and Drug Administration (FDA) as part of their process for approving new medical products for use in humans. The FDA requires medical products undergo extensive testing in animals and/or other models (pre-clinical) before they can be tested in human subjects (clinical). Clinical trials are conducted in three phases (Phase 1, 2, and 3) to prove the safety and effectiveness of a drug, vaccine, or device for the targeted disease or medical condition. Each successive test includes larger numbers of human subjects and requires FDA approval prior to proceeding with the next test. Work conducted in this PE primarily focuses on advanced technology maturation activities required to obtain FDA approval to initiate Phase 2 clinical trials, although some high risk technologies may require additional maturation and FDA approval to initiate Phase 3 clinical trials prior to transition into a formal acquisition program. Activities in the PE may include completion of pre-clinical animal studies, as well as studies involving human volunteers.

030 0603002A MEDICAL ADVANCED TECHNOLOGY
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Military Relevant Infectious Disease efforts mature and demonstrate medical countermeasures against naturally occurring diseases of military importance as identified by worldwide medical surveillance and military threat analysis. Example countermeasures include: vaccines, prophylactic interventions, diagnostics, therapeutic drugs, and methods for controlling disease-carrying insects. Countermeasures are developed against parasitic diseases (e.g., malaria and leishmania), and bacterial (e.g., diarrheal diseases and scrub typhus) and viral threats (e.g. hantaviruses and dengue).

Combat Casualty Care efforts mature and demonstrate methods and technologies that can improve medical treatment outcomes for battlefield injuries. These technologies include: drugs, fluids, devices, and diagnostics for resuscitation, treatment of injuries, and life support. Example medical devices and products include blood clotting drugs, freeze-dried plasma, neuroprotective drugs (protection against brain impairment), and operator assisted and automated critical care systems to provide life support functions (resuscitation, and oxygen and fluid administration). Products for prevention of combat maxillofacial (face/neck) injuries and dental disease are also tested and validated.

Military Operational Medicine (MOM) efforts mature and demonstrate biomedical solutions that protect Soldiers and enhance their performance in the face of multiple stressors in operational and training environments. Example products include biomedically-validated design criteria for body armor and helmets, injury models, and physiological algorithms, and factors for monitoring the affects of high altitude, extreme temperatures, hydration, fatigue, isolation, and sleep deprivation on Soldier health and performance. MOM research also addresses lessons-learned from research and treatment of deployment-related illnesses to gain a better understanding of the health threats in military deployments.

The PE contains no duplication with any effort within the Military Departments and is related to, and fully coordinated with, work funded in PE 0602787A. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by Walter Reed Army Institute of Research, Silver Spring, MD; US Army Medical Institute of Chemical Defense, Aberdeen Proving Ground, MD; US Army Medical Institute of Infectious Diseases, Fort Detrick, MD; US Army Research Institute of Environmental Medicine, Natick, MA; US Army Institute of Surgical Research, Fort Sam Houston, TX; US Army Aeromedical Research Laboratory, Fort Rucker, AL; the Naval Medical Research Center, Silver Spring, MD and US Army Medical Detachment Brooks, San Antonio, TX.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	300784	50757	58521	56804
Current BES/President's Budget (FY 2008/2009)	293791	299017	53274	54863
Total Adjustments	-6993	248260	-5247	-1941
Congressional Program Reductions		-1142		
Congressional Rescissions				
Congressional Increases		251600		
Reprogrammings	-6993	-2198		
SBIR/STTR Transfer				
Adjustments to Budget Years			-5247	-1941

Software limitations preclude listing the One hundred and twenty FY07 congressional adds totaling $241142 (after adjustments for Congressional Undistributed Reductions) that were added to this PE. To see the list of congressional adds for this PE, please refer to the Conference Report on Defense Appropriations for Fiscal Year 2007, House Report 109-676, pages 248 to 252.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603002A - MEDICAL ADVANCED TECHNOLOGY**	**800**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
800 TELEMEDICINE TESTBED	2931	3818	5425	4118	3994	4080	4170	4261

A. Mission Description and Budget Item Justification: This project funds the advancement and validation of prototype advanced concepts and enabling technology pertaining to Force Health Protection. The goal is to improve warfighter health, survivability, and performance while reducing the requirement for deployed medical professionals. Major efforts include collaborative tools for mission planning and rehearsal that enable deployment of optimally tailored medical support for a deployed force; medical modeling and simulation; medical command and control; and forward echelon telemedicine presence. The current focus is to provide increased situational awareness of the operational and health risks of fatigue, exposure to environmental toxins (toxic industrial chemicals/materials), and enabling technologies for reducing these risks. Evaluation of fatigue countermeasures to validate methods used to mitigate the effects of fatigue and sleep loss that adversely affects the Soldier's ability to sustain both health and performance during prolonged military operations. Additionally, environmental monitoring efforts are directed at demonstration and validation of an Environmental Sentinel Biomonitor that can identify the presence of toxic industrial chemicals in water and monitor potable water sources. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the US Army Center for Environmental Health Research (USACEHR), Fort Detrick, MD; and the Walter Reed Army Institute of Research (WRAIR), Silver Springs, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Sleep Research/Environmental Monitoring: In FY06, verified that increasing levels of sleep loss adversely affects cognitive function, ability to perform risk assessment, sound decision-making process, and situational awareness. Demonstrated and validated the effectiveness of stimulants (caffeine) to improve cognitive abilities. The findings demonstrated that tested stimulants enhanced alertness; however, each stimulant restores only certain aspects of cognitive performance. In FY07, integrate mature components into the Environmental Sentinel Biomonitor (ESB) and conduct field tests. Conduct field studies to validate the Fatigue Intervention Recovery Model (FIRM) to predict military performance (i.e. tactical vigilance, situational awareness, marksmanship). In FY08, will conduct clinical studies of the efficacy of non-traditional fatigue countermeasures (drug interventions) for restoring cognitive performance during extended periods of sleep loss (i.e. cognitive enhancers). The cognitive capacities to be tested will include: decision-making, situational awareness, and judgment. In FY09, will conduct phase II clinical studies to validate the efficacy of cognitive enhancers as a fatigue countermeasure in an operational environment. Integrate ESB components and conduct field testing of the composite system.	2931	3710	5425	4118
Small Business Innovative Research/Small Business Technology Transfer Programs		108		
Total	2931	3818	5425	4118

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603002A - MEDICAL ADVANCED TECHNOLOGY**	**810**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
810 IND BASE ID VACC&DRUG	16844	21003	21368	22206	20703	20632	21131	21518

A. Mission Description and Budget Item Justification: This project matures and demonstrates medical countermeasures to naturally occurring infectious diseases that can adversely affect the Future Force. Infectious diseases are a major threat to U.S. military forces. Program focus is on prevention, diagnosis and treatment of diseases that can seriously hamper military mobilization, deployment, and effectiveness. Infectious diseases that have had a significant impact on Soldier health include malaria and leishmaniasis (classified as parasitic diseases), bacterial diseases that cause diarrhea (e.g., Shigella, enterotoxigenic Escherichia coli (ETEC), and Campylobacter), and viral diseases such as Dengue Fever. Additional disease threats to deployed and mobilizing forces include meningitis, viral encephalitis, and viruses that cause internal bleeding and kidney failure. Promising medical countermeasures identified through applied research conducted under PE 0602787A, project 870 are further matured under this project. Example countermeasures include: vaccines to protect against malaria, diarrhea, dengue, meningitis, and hemorrhagic fever; insect control measures; and diagnostic devices. Advanced techniques and prototype devices for rapid battlefield identification and diagnosis of infectious diseases are tested and refined. Work is conducted in compliance with US Food and Drug Administration (FDA) regulations for medical products that are intended for human use. FDA requirements include producing drug and vaccine pilot and full production lots using Good Manufacturing Practices (GMP) together with non-clinical studies of these products to support New Drug Applications, and demonstrating their safety and effectiveness in humans under FDA Investigational New Drug (IND) rules. Work is managed by the US Army Medical Research and Materiel Command. The Army is Executive Agent for infectious disease research within the DOD and is responsible for programming and funding all research on Joint and Service-specific requirements, thereby precluding duplication of effort within the Military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD, and its overseas laboratories; the US Army Medical Research Institute of Infectious Diseases (USAMRIID), Fort Detrick, MD; and the Naval Medical Research Center (NMRC), Silver Spring, MD, and its overseas laboratories.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Drugs to Prevent/Treat Parasitic Diseases: Conduct FDA-required nonclinical (lab-based) testing, select promising malaria and leishmaniasis drug candidates for testing in human subjects, and prepare data package required for FDA approval to proceed with testing in humans. Studies have shown that the malaria parasite can become resistant to treatment with existing drugs, which makes it necessary to continually research new and more effective treatments. In FY06, completed two of five planned initial human subject safety trials (Phase 1, 30-40 volunteers in the United States and Kenya) with Artesunate, a candidate drug to treat severe malaria, and started second clinical safety trial of this drug. Selected a candidate antifolate malaria drug being developed with partner for malaria prevention for testing in humans and prepared data package to gain FDA approval for human subject trials. Assessed for potential human testing two existing drugs that show promise in treating leishmaniasis, a parasitic disease that causes skin ulcers. In FY07, complete human testing of Artesunate and prepare data package for FDA New Drug Application; begin testing of the antifolate antimalarial drug in human subjects (20-40 volunteers, 6-12 months trial) to replace Larium, a drug that may have undesirable side effects; and complete assessment of existing leishmaniasis drugs and proceed with preparation for testing in human subjects if warranted. In FY08, will conduct human subject safety trials (30 volunteers, 8 months trial) on two new antimalarial drugs and assess two existing drugs for effectiveness in treating leishmaniasis. In FY09, will continue testing and studies to identify new candidate antimalarial drug prevention and treatment	3688	3287	2711	3140

candidates and down select current drugs under study as new leishmaniasis treatment. Drugs found effective and safe will transition into advanced development based upon test results.				
Vaccines for Prevention of Malaria: Conduct FDA-required nonclinical (lab-based) testing of candidate vaccines, prepare data package required for FDA approval to proceed with further testing, and test promising malaria vaccine candidates in human subjects. A malaria vaccine against the severe falciparium form of malaria and the relapsing vivax form could reduce the need for antimalarial drugs and address the continuing problems with parasite drug resistance and compliance issues with taking antimalarial drugs. In FY06, continued four clinical trials (between 20-400 volunteers in each, duration 6-18 months each) to test safety and effectiveness of promising vaccine components that may be used to formulate a more effective malaria vaccine. In FY07, continue ongoing clinical trials and conduct large scale testing of one of the malaria vaccine candidates (400 African volunteers over 18 months); and establish a partnership with industry for manufacturing a multicomponent vaccine for advanced human subject trials and FDA licensing of a malaria vaccine. In FY08, will finalize a multicomponent candidate malaria vaccine for larger scale testing in human subjects if candidate components prove safe and effective in clinical trials, and initiate clinical testing of a new vivax malaria vaccine. In FY09, will continue refinement of the final formulation of the malaria vaccine and continue ongoing clinical trials to demonstrate effectiveness of candidate vaccines. Vaccines found effective and safe will transition into advanced development based upon test results.	5032	5610	5690	5434
Bacterial Threats Vaccine Program: Conduct FDA-required non-clinical (lab-based) testing of candidate vaccines, select promising candidate vaccines against diarrhea (significant threat during initial deployments), and meningococcal vaccine candidates (a threat during deployment, training and military families) for testing in human subjects, and prepare data package required for FDA approval to proceed with further testing. In FY06, terminated research on a diarrheal vaccine after it failed in human subject trials; completed human subject safety/effectiveness trials of additional candidate vaccines against two forms of dysentery (bacterial invasion of the gut) with analysis pending. Started initial human subject trial (20-40 volunteers, 6-12 months trial) of a new meningitis vaccine to demonstrate enhanced safety. In FY07, continue testing of candidate diarrheal vaccines and manufacture pilot lot of an improved third diarrheal vaccine for a safety trial using human subjects; and complete initial clinical testing of meningitis vaccine started in FY06. In FY08, will continue with ongoing human subject testing of candidate vaccines by conducting extended Phase 1 clinical trials for a dysentery vaccine (100 volunteers, 12 months trial), including a second-generation oral dysentery vaccine if the current candidate fails in testing. Initiate Phase 1 clinical trials (20-40 volunteers, 6-12 months trial) of two additional diarrheal vaccines. In FY09, will continue larger scale human subject testing for effectiveness of diarrheal vaccine candidates (200 subjects, 12 months trial) and initiate further human subject testing (20-40 volunteers, 6-12 months trial) of a genetically modified meningitis vaccine.	4961	5485	6592	7213
Viral Threats Vaccine Program: Select most promising vaccine candidates for testing in human subjects against dengue hemorrhagic fever (an increasing threat world-wide) and hantavirus, (severe viral infection that causes internal bleeding). Conduct FDA-required nonclinical testing (lab-based) and disease models of candidate vaccines, and conduct clinical testing of vaccines. In FY06, resumed testing of a DNA-based dengue virus vaccine in human subjects after completing an investigation into an adverse reaction experienced by a participant in the test; completed testing of a second generation dengue virus vaccine in animals as potential lead if current vaccine candidate fails during testing; initiated human subject safety testing (20 volunteers) of one type of hantavirus (Hantaan) vaccine. Conducted final FDA required nonclinical testing of a second strain of Hantavirus vaccine (Puumala) for a combined, broadly protective vaccine against hantaviral hemorrhagic fever strains (HFRS). In FY07, continue testing of the dengue DNA vaccine, manufacture pilot lot of a second-generation dengue vaccine and initiate human safety trial (40 volunteers), complete animal testing and studies with second hantavirus vaccine against a second major HFRS subtype (Puumala virus), manufacture clinical lot of broad spectrum HFRS vaccine (a combined Puumala/Hantaan virus vaccine) for testing in human subjects. In FY08, will continue ongoing human subject testing of multiple hemorrhagic virus vaccines including testing of broad spectrum Hantavirus (HFRS) (200 subjects, 18 months trial) and dengue	2353	4133	4024	4042

vaccines (40 subjects, 6 months trial). In FY09, will continue with long-term human subject testing of hemorrhagic virus vaccines if study results support their continuation, and down select to most effective and safe dengue vaccine candidates based on larger scale studies that include both adults and children (100-300 volunteers in each group).				
Insect Vector Control and Infectious Disease Diagnostics Programs: Conduct field and human subject testing of field medical diagnostic devices and insect control measures. In FY06, assessed Leishmania DNA-based diagnostic systems in human subject testing, matured, and demonstrated sand fly vector control components such as light traps for collecting insects and identification aides, and demonstrated the effectiveness of tools developed for use by deployed Preventive Medicine Units (PMUs) for detecting relevant diseases such as leishmania and sand fly fever virus in insects. In FY07, conduct additional field and clinical testing of medical diagnostic devices and insect control measures including comprehensive field testing of sand fly control measures, conduct FDA required testing of medical diagnostic systems reaching maturity with focus on commercializing systems, and complete initial human subject testing of Leishmania diagnostic systems or transfer to commercial partner. In FY08, will continue to conduct field testing or clinical testing of medical diagnostic devices and insect control measures with potential completion of several components of the sand fly control tools for PMUs; will conduct human subject trials to complete development of an FDA-approved, field-deployable point-of-care (for use in the clinical) diagnostic device for cutaneous leishmaniasis (a skin ulcer caused by the parasite), and FDA-approved diagnostic tests for latent infection (infection without clinical disease) with Leishmania parasites. In FY09, will transition selected components of sand fly control tools e.g., light traps, screening assays and bednets; will continue to conduct field testing and clinical testing of medical infectious disease diagnostic devices, will transition a clinical diagnostic test for Leishmania infection, and continue to refine and test diagnostic devices and other insect vector control items to attain FDA-approval.	810	2000	2351	2377
Small Business Innovative Research/Small Business Technology Transfer Programs		488		
Total	16844	21003	21368	22206

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603002A - MEDICAL ADVANCED TECHNOLOGY**	**819**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
819 FLD MED PROT/HUM PERF	988	1159	1202	1265	1235	1267	1295	1323

A. Mission Description and Budget Item Justification: This project funds supports the Medical and Survivability technology areas of the Future Force with laboratory validation studies and field demonstrations of biomedical products designed to protect, sustain, and enhance Soldier performance in the face of a myriad of environmental, physiological stressors, and materiel hazards encountered in training and operational environments. This effort focuses on identifying stressors, and validating methods for assessing risk to the Soldier due to both physical and operational stressors. Research matures and demonstrates methodologies and tools associated with biomechanical-based health risks, injury assessment/prediction, Soldier survivability and performance during continuous operations. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Physical Performance Enhancement: In FY06, validated the effectiveness of resistance training in enhancing performance and reducing overall training injuries. Implementation of these findings reduces the incidence of training injuries and thereby enhances Soldier readiness. In FY07, validate the effectiveness of measuring bone and muscle metabolism as a non-invasive injury prediction tool for monitoring the course of musculoskeletal adaptation to strenuous training. In FY08, will validate a method to evaluate pre and post deployment physical status (i.e., body composition, performance, and muscle strength). In FY09, will validate an integrated longitudinal model for predicting individual Soldier and unit musculoskeletal injury and adverse physical performance outcomes.	988	1127	1202	1265
Small Business Innovative Research/Small Business Technology Transfer Programs		32		
Total	988	1159	1202	1265

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603002A - MEDICAL ADVANCED TECHNOLOGY**	**840**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
840 COMBAT INJURY MGMT	16555	22259	23280	25190	25142	25324	25882	26451

A. Mission Description and Budget Item Justification: This project matures, demonstrates, and validates new medical technologies and methods to improve survivability and assure better medical treatment outcomes for warfighters wounded in combat and military operations other than war. Major efforts include hemorrhage control (novel bandages and techniques), resuscitation (fluid replacement and oxygen delivery), prognostics and diagnostics (predictive indicators, decision aids, and devices for triage), and life support (computerized monitors and autonomous patient care devices). Additionally, efforts include combat trauma therapies (novel treatments to minimize tissue damage and accelerate restoration of function) and development of realistic trauma simulators for training of medical personnel. Included are new candidate intravenous clotting drugs; advanced technologies for regrowth of tissue and repair of extremity injuries; freeze-dried plasma to treat hemorrhage; neuroprotective drugs to minimize consequences of head injury; preventive dental care technologies to fight dental disease; and other capabilities to guide and assist the combat medic in the care of wounded on the battlefield and during evacuation. All research is conducted in compliance with US Food and Drug Administration (FDA) requirements. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the US Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX; the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA; and the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Hemorrhage Control, Blood, and Resuscitative Fluids: Includes work required to validate safety and effectiveness of drugs and medical procedures to prevent or minimize secondary organ failure (including brain and spinal cord injury) after major trauma. In FY06, completed animal studies and sample analyses for blood-clotting products; tested FDA-approved complement inhibitors (CI), i.e. fluids used to reduce tissue and organ injury in animal models to confirm their safety. Two of the CI products improved survival during excessive blood loss. In FY07, determine limitations of activated Factor VII (injectable clotting factor) and freeze-dried plasma to control internal bleeding through animal testing; verify safety and effectiveness of freeze-dried plasma and PDHA, a blood-clotting product derived from blood cells, in human clinical studies; demonstrate the benefit of complement inhibition (reduction of swelling and organ failure) in a large animal model; conduct multiple animal studies using various blood components to compare to the effectiveness of whole blood as a resuscitation fluid; and validate new regimens for treatment of shock. In FY08, will continue animal studies of combinations of products (freeze-dried plasma, synthetic red blood cells, activated Factor VII, fibrinogen) and treatment strategies to best control all forms of bleeding; continue clinical studies of a blood-clotting product derived blood cells for potential to increase survival; determine best transfusion practices and storage practices for blood products; and begin safety and effectiveness clinical trial of CI in hemorrhage-trauma patients. In FY09, will continue to evaluate combinations of products and treatment strategies to best control all forms of bleeding and publish use guidelines for immediate implementation; finalize human clinical trial data to determine maturity relative to FDA approval for PDHA; and continue human clinical trial of CI therapy in hemorrhage-trauma patients.	7258	13340	13464	9760
Combat Trauma Therapies: Includes work required to validate safety and effectiveness of drugs, biologics, and medical procedures intended to minimize the immediate and long-term effects from battlefield injuries. In FY06, completed testing necessary to transition a prototype composite long-bone splint to advanced development; tested effectiveness of combinations of growth factors (chemical or	3715	3235	3932	6736

biological agents) that accelerate bone regeneration to select best bone substitute; and initiated clinical validation (human testing) of brain trauma biomarkers. Brain trauma research is coordinated with related efforts under the Military Operational Medicine Research Program in PE 0602787A, project 878. In FY07, begin an expanded human safety and efficacy trial for an experimental neuroprotectant drug (NNZ2566) as a treatment for acute silent seizures resulting from a brain injury and continue evaluation of brain trauma biomarkers. In FY08, will continue clinical development of NNZ2566 and complete clinical validation of brain trauma biomarkers. In FY09, will begin extensive multi-center clinical validation of most promising tissue regeneration treatment regimens, complete expanded human safety and efficacy clinical trials for NNZ2566; integrate validated biomarkers and standard physiological parameters (i.e. blood oxygen, chemistry, and pH) in a prototype device for brain trauma biomarker diagnostics and test it in a human clinical trial.				
Far-Forward Medical Systems: Includes diagnostic and therapeutic medical devices, algorithms, software, and data processing systems for resuscitation, stabilization, life support, and dental care. In FY06, validated a special breathing valve that aids blood flow to the heart, completed software specifications for the Computer Assisted Resuscitation Algorithm (CARA), completed formulation of antimicrobial gum to prevent dental disease, and conducted field evaluation of the Warfighter Physiological Status Monitor (WPSM) in realistic training scenarios. The WPSM efforts are coordinated with related efforts under the Military Operational Medicine Research Program PE 0602787A, project 869 and PE 0603002A, project 800. In FY07, refine usage parameters for a special breathing valve that military medical personnel use at all locations on the battlefield as a non-invasive treatment of shock; complete clinical evaluation of the CARA in operating room situations; begin human Phase I clinical testing of the antimicrobial, antiplaque chewing gum; and complete activities required to transition the first generation WPSM to PEO Soldier. In FY08, will complete clinical testing of the automated ventilation algorithm used during surgical operations and intensive care settings; and continue human studies of the antimicrobial, antiplaque chewing gum. In FY09, will start clinical trial of oxygen, ventilation, and fluid resuscitation algorithms integrated into either the Army's integrated litter or the Navy's Lightweight Trauma Module for casualty transport; will complete clinical trials and data analyses required to transition antimicrobial, antiplaque chewing gum to advanced development; and complete prototype development and data analysis of a diagnostic device that provides the field medic enhanced decision support capability for casualty treatment far forward on the battlefield.	4224	3979	5342	7849
Combat Casualty Bioinformatics and Simulation: Includes testing and validation of a data management system to capture and analyze time series data such as heart and respiration rates, and testing and validation of durable and realistic casualty simulators for initial and reinforcement training of medical care providers. In FY06, conducted testing of the RDECOM Advanced Medic Training Technologies system to assess training effectiveness and interoperability. In FY07, finalize prototype by incorporating results from tests run by RDECOM in medic training classes at the AMEDD Center and School. In FY08, will complete revisions of algorithms intended to enhance recovery of usable physiological data and validate use of high-frequency features of electrophysiological signals (electrical measurements of body function) to predict the need for a Life Saving Intervention (LSI). In FY09, will complete development and test validity of an algorithm that incorporates low-, as well as, high-frequency electrophysiological features to provide an automated decision assist output that identifies the specific physiologic state of a patient and the requirement for a specific LSI.	1358	1081	542	845
Small Business Innovative Research/Small Business Technology Transfer Programs		624		
Total	16555	22259	23280	25190

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603002A - MEDICAL ADVANCED TECHNOLOGY**	**FH4**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
FH4	FORCE HEALTH PROTECTION - ADV TECH DEV	1580	1959	1999	2084	2009	2050	2095	2141

A. Mission Description and Budget Item Justification: This project funds efforts that mature, validate, and support enhanced force health protection of Soldiers against threats in military deployments. Health monitoring tools are matured to rapidly identify deployment stressors that also affect health of Joint Forces. These databases and systems enhance the DoD's ability to monitor and protect against adverse changes in health, especially mental health affects caused by changes in brain function. This effort builds on knowledge from a decade of research on Gulf War Illnesses (GWI) and other chronic multi-symptom illnesses that have suspected neurotoxin (toxin that destroys/damages the nerve cells) and neuropsychological (branch of psychology dealing with the nervous system, especially brain function) origins. FHP work is conducted in close coordination with the Department of Veterans Affairs. The program is maturing the development of global health monitoring (e.g., neuropsychological monitoring test methodologies), validating clinical signs and symptoms correlating to medical records, diagnosed diseases, and mortality rates. The key databases supporting this program are the Millennium Cohort Study and the Total Army Injury and Health Outcomes Database (TAIHOD). These databases allow for the examination of interactions of psychological stress, and other deployment and occupational stressors that affect warfighter health behaviors. This project contains no duplication with any effort within the Military Departments and includes direct participation by other Services working on Army projects. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA; and the Naval Health Research Center (NHRC), San Diego, CA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Health Research: In FY06, expanded enrollment in the Millennium Cohort Study (i.e. a study which created a database designed to evaluate the long-term health effects of military service, especially deployments) to more than 108,000 participants, of which nearly one third have recent deployment experience. Conducted long-term validation and reliability analyses of the Cohort database to determine statistical relevance and magnitude of disease associated with GWI. The analyses verify that the Cohort Study will provide an unprecedented capability to understand the health impact of deployment and other occupational exposures prospectively. Validated a significant and continuing increase in disability discharges due to physical injuries over the past decade and identified disability types for targeted focus. In FY07, conduct major data collection for the Millennium Cohort Study by initiating enrollment of more than 30,000 Service members (Panel 3) to further validate and track important health effects of deployment and other military exposures over time. In FY08, will complete enrollment of Millennium Cohort Panel 3 and conduct analyses on data validity, reliability, as well as mental and functional health outcomes. In FY09, will conduct a systematic validation of prospective data to correlate relationships in chronic health effects and multi-symptomatic illnesses. Drawing from disability database analysis to isolate causes, implement, and track results for the most promising interventions to reduce chronic disabilities.	1580	1904	1999	2084
Small Business Innovative Research/Small Business Technology Transfer Programs		55		
Total	1580	1959	1999	2084

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	100095	96575	53890	57615	70049	66545	78004	82986
313	ADV ROTARYWING VEH TECH	27144	31173	42475	45726	56412	51866	57271	59476
435	AIRCRAFT WEAPONS	2765	3298	2908	3201	3744	2672		
436	ROTARYWING MEP INTEG	1868	2691				1745	10245	12792
447	ACFT DEMO ENGINES	7356	8284	8507	8688	9893	10262	10488	10718
BA7	AVIATION ADVANCED TECHNOLOGY INITIATIVES (CA)	57607	47915						
BA8	VECTORED THRUST DUCTED PROPELLER (CA)	3355	3214						

A. Mission Description and Budget Item Justification: The Aviation Advanced Technology Development program element (PE) matures and demonstrates manned and unmanned rotary wing vehicle (RWV) technologies and systems in support of the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. Within this PE, aviation technologies will be matured and integrated into realistic and robust demonstrations. Work will involve maturing manned and unmanned teaming in combat and combat support operations for attack, reconnaissance, air assault, and command and control missions. Integrated unmanned operations will be advanced through autonomous collaboration and maturation of advanced unmanned technologies. Components and subsystems that enable increased system survivability and crew protection, platform lift, maneuverability, agility and endurance, autonomous flight, common mission equipment architecture, team-based intelligent mission operations, manned / unmanned battle space integration, and/or improved operational availability and reduced maintenance will be demonstrated. Major efforts within this PE include component maturation and flight demonstrations; manned-unmanned system teaming demonstrations; operating and support cost reduction applications; joint concept exploration including multi-role rotorcraft and integrated full-spectrum aircraft survivability. This PE also supports the maturation and demonstration of major aviation subsystems in propulsion, drive-trains, aeromechanics and flight controls for future force manned and unmanned aviation systems in accordance with the Army Aviation Transformation Plan. This PE also matures manned and unmanned rotorcraft sensor and weaponization technologies for air-to-air and air-to-ground application. Projects BA7 and BA8 fund congressional interest items. Department of Defense (DoD) systems such as the US Army AH-64 Apache, UH-60 Black Hawk, CH-47 Chinook, Armed Reconnaissance Helicopter, Light Utility Helicopter; the US Navy SH-60 Seahawk; and the US Marine Corps V-22 Osprey, AH-1 Cobra, and CH-53 Super Stallion benefit and are supported directly or indirectly by this PE. Related applied research is conducted under PE 0602211A (Aviation Technology). Aircraft survivability efforts in this PE are coordinated with PE 0603313A (Missile and Rocket Advanced Technology) and PE 0603270A (Electronic Warfare Technology). Efforts under this PE transition to programs supported by PE 0603801A (Aviation - Advanced Development), PE 0604801A (Aviation - Engineering Development), and PE 0604270A (Electronic Warfare Development). This PE does not duplicate any efforts within the Military Departments and supports Project Reliance for which the Army is the lead service for the maturation of rotorcraft science and technology. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Aviation and Missile Research, Development, and Engineering Center with facilities located at Redstone Arsenal, AL; Fort Eustis, VA; and Moffett Field, CA.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	106577	64654	80406	90682
Current BES/President's Budget (FY 2008/2009)	100095	96575	53890	57615
Total Adjustments	-6482	31921	-26516	-33067
Congressional Program Reductions		-19069		
Congressional Rescissions				
Congressional Increases		51700		
Reprogrammings	-6482	-710		
SBIR/STTR Transfer				
Adjustments to Budget Years			-26516	-33067

FY08 and FY09 funds decreased to provide additional funding to 6.2 efforts (622211) and to fund higher priority projects.

Twenty-three FY07 congressional adds totaling $49553 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($2157) Unmanned Aerial Vehicle - Resupply
($1726) Locust USA Heavy Fuel Burning Engines for UAVs
($958) Reconfiguration Tooling System
($6230) Excaliber Tact UCAV
($4601) Process Tech for Replacement Part Production
($958) Fuel Cells for Mobile Robotic System Projects
($958) Nanocrystaline Diamond Rotor Blade Protection
($2492) Improved VAROC/UAV Compression System Dev
($3738) Mission Execution Technology Impementation
($2875) Universal-Full Authority Digital Engine Control
($1535) Versatile Affordable Adv Turbine Engine (VAATE)
($1294) Vertical Takeoff & Landing UAV
($958) Alternate Payload Munition (APL-BU)
($1246) CompositeTail for Armed Reconnaissance Helicopter
($479) Directed Energy Systems for UAV Payloads
($1917) Drive Sys Composite Structual Component Reduction
($1869) Helmet Mounted Display/Visor Projection
($1869) Integrated Aircraft Test Bed
($958) Lgtwt Sapphire Transparent Armor for Rotorcraft

($1054) Quick Materiel Express Delivery System
($4697) Rapid Prototyping for Special Projects
($1869) Rapid Tactical Integration and Fielding of Systems
($3115) Vectored Thrust Ducted Propeller Compound Helo

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**	**313**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
313 ADV ROTARYWING VEH TECH	27144	31173	42475	45726	56412	51866	57271	59476

A. Mission Description and Budget Item Justification: The Advanced Rotary Wing Vehicle (RWV) Technology project matures and demonstrates rotary wing manned and unmanned platform technologies for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The Army Aviation Transformation Plan requires rotorcraft systems that have significantly increased / improved lift, range, survivability, and mission capability with an overall reduction in logistics and cost of operation. The critical technologies to support these capabilities will be matured through the demonstration of key subsystems such as rotors, active controls, structures, drive-train, integrated threat protection technologies, as well as prototype UAVs. The near-term demonstration of Vertical Take Off and Landing (VTOL) UAVs will focus on the A-160 Hummingbird for Reconnaissance, Surveillance, and Target Acquisition (RSTA) and communications relay capabilities. The integration of technology into UAV and manned teaming operations involves the merging of a common operating architecture and incorporates team survivability. The Enhanced Rotorcraft Drive System program provides a 40 percent increase in power-to-weight ratio, 30 percent reduction in both production and Operating and Support (O&S) costs and a 15 decibel (dB) reduction in noise for the drive-systems of both manned and unmanned rotorcraft. These technologies are a significant contributor to Future Force capability and enable a 40 percent increase in payload for the AH-64 Apache, a 20 percent increase in range for the UH-60 Black Hawk, and over a 25 percent increase in range for the CH-47 Chinook over their respective baselines. The Survivable, Affordable, Reparable Airframe Program (SARAP) reduces weight and increase the survivability for both manned and unmanned systems. This technology is a significant contributor to Future Force capability and enables an increase in range for the UH-60 Black Hawk. The Rotorcraft Survivability program reduces Infra-Red (IR) signatures by up to 50 percent, incorporates innovative directional IR jamming, small arms and Rocket Propelled Grenades (RPG) hostile fire warning, threat location cueing and eye-safe visual dazzler components to improve aircraft survivability by at least 50 percent against small arms, RPG and Man-Portable Air Defense Systems (MANPADS) threats. This project also supports Concept Exploration of a Joint Heavy Lift rotorcraft platform. This effort assesses the technologies and system design trades to enable vertical mounted maneuver and Naval sea-basing. The Capability-Based Operations and Support Technologies (COST) program improves operational availability and reduces maintenance time by providing detection of 75 percent of the critical mechanical/electrical component failures, and 40 percent prognostic capability for long lead-time airframe and propulsion components, resulting in timely delivery of flight-critical parts. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Aviation Applied Technology Directorate of the Aviation and Missile Research, Development, and Engineering Center located at Fort Eustis, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
UAV Technology Demonstration: In FY06, continued engineering and ground testing to resolve unexpected technical problems with the vehicle internal combustion engine driveline. Began integrating into the test vehicle a Commercial Off-The-Shelf turboshaft engine with new 2-speed transmission to provide reliable power for high rotor RPM, high gross weight, and endurance flight testing. Continued to upgrade vehicle systems for reliability. In FY07, fly UAV testbed with turboshaft engine installed. Continue to use full-power in a safer ground testing environment to increase operational hours and experience in order to mitigate risk during flight operations. Conduct flight tests (involving approximately 20 flights of varying duration) to demonstrate envelope for range, endurance (up to 20 hours), altitude (up to 30,000 ft.) and gross weight (up to 5000 lbs.).	10000	14407		
Robotics Collaboration: In FY06, completed systems integration, checkout, and preliminary flight validation of Unmanned Autonomous	4635	2860		

Collaborative Operations (UACO) architecture on the RMAX UAV platform. Demonstrated UACO tactical behaviors using two RMAX UAVs collaborating to execute tasks assigned by a single operator. Completed integration of Soldier-Machine Interface software capable of high-level tasking by the operator from the vehicle mounted Tactical Control Unit or the Soldier-borne Tablet-based Control Unit. Integration and preparation of UGVs for UACO testing is ongoing. In FY07, conduct demonstration system testing and trial runs with three RMAX UAVs and two UGVs using a HMMWV-mounted Control Unit. Conclude program with final demonstration of Air-Ground Cooperative Engagement using Soldiers commanding and assessing multiple autonomous UAVs and UGVs at the McKenna MOUT Range at Ft. Benning, GA. Work on this effort is also being accomplished under PE/project: 62716/H70; PE/project: 62211/47A; PE/project: 63005/497 and PE/project: 63005/515.				
Rotorcraft Survivability: In FY06, began development of a low-cost aircraft self-protection suite to detect, disrupt, and defeat small arms fire, rocket-propelled grenades (RPGs), and current and next-generation Man Portable Air Defense System (MANPADS) threats. Integrated an adaptive Infra-red (IR) engine exhaust suppressor, super-lightweight thermal insulation, and multi-spectral coatings. Demonstrated up to 50% reduction in total aircraft IR signature in flight, which yields a 25% to 30% reduction in IR MANPADS lock-on range. In FY07, continue the maturation, evaluation, and integration of a hostile fire indicator, visual cues to threat location, and a visual targeting disruption system. In FY08, will integrate a suite of candidate survivability technologies on a Black Hawk helicopter and perform flight tests to quantify the increase in threat detection range as well as the reduction in the threats' lock-on range and targeting accuracy. Will begin developing a fully-integrated team-based aircraft self-protection suite for defeating current MANPADS threats, small arms and RPGs, anti-tank guided missiles, and radar threats, utilizing the concept of distributed survivability. Distributed survivability is where the team can share detection and countering information and effects (such as where one platform does not have a working piece of equipment or where a UAV might not have the capability to fly with the added weight of the detection and countering devices). Will develop UAV passive signature reduction technologies and integrate advanced countermeasures and threat warning systems. In FY09, will integrate cognitive decision aiding technologies (developed earlier under the Survivability Planner Associate Rerouter/Manned-Unmanned Rotorcraft Enhanced Survivability effort) into multiple manned and unmanned aircraft and complete the team-based self-protection suite. Work on this effort is also being accomplished under PE/project: 62270/442 and PE/project: 63270/K16.	4509	7784	8777	7311
Rotorcraft Structures: In FY06, fabricated virtual prototype (full digital definition and simulations/models) validation hardware for ballistic, static, and crash testing and transitioned Survivable, Affordable, Repairable Airframe Program structural technologies, concepts, and methodologies to PEO Aviation and the US Navy in support of current and developmental manned and unmanned rotary wing systems such as UH-60 Black Hawk, CH-47 Chinook, and CH-53 Super Stallion.	1000			
Enhanced Rotorcraft Drive System (ERDS): In FY06, refined the design of ERDS (composite housing and helical face gears) applicable for upgrades to the Armed Reconnaissance Helicopter, UH-60 Black Hawk, the Mission Enhanced Little Bird and scaleable to Joint Heavy Lift aircraft. Initiated the development of drive train diagnostic algorithms for use in the Army's Health and Usage Monitoring System. In FY07, complete design, analysis, and fabrication for the composite gearbox housing; complete analytical tools for helical face-gear manufacturing and profile/mesh development; start surface durability testing of advanced gear materials in helical face-gear configuration; begin fabrication of support system components for the demonstrator transmission; generate failure mode analysis and diagnostic algorithms for face-gear applications; fabricate investment cast housing for gearbox; perform 200 hour testing of investment cast gearbox housing; and conduct detailed design and fabrication of tooling for integral composite coupling/shaft. In FY08, will begin fabrication of the helical face gears, gears for the enhanced power density tail rotor gearbox, and composite shafts. Will conduct demonstration testing of the composite gearbox housing. In FY09, will complete fabrication of components; will conduct endurance testing of the helical face gear design; will perform demonstration tests of the composite shaft/coupling, composite main rotor drive shaft, and tail rotor enhanced power density gears. Will validate diagnostic algorithms as part of the demonstration tests.	1000	2243	4190	5000

Joint Heavy Lift (JHL): In FY06, advanced the five competing concept designs and assessed their performance characteristics as part of the ongoing joint requirements refinement. Completed an initial Map Exercise, three iterations on the baseline designs, and initiated survivability and downwash analyses. The Map Exercise allowed contractors to participate with soldier/planner/tacticians at Fort Rucker in a simulated exercise that utilized their design concepts in several typical scenarios. Both contractor and Government participants gained understanding of the merits and demerits of their design concepts to enable adjustments in their plans. In FY07, complete the final Concept Refinement Design Review; complete Concept Design and Analysis including an Independent Government performance and risk assessment; initiate and complete a preliminary Joint Concept Analysis of Alternatives; and develop a draft Capabilities Development Document.	6000	3065		
High Altitude Long Endurance (HALE) Platforms: In FY08, will conduct first flight and begin expansion of envelope to demonstrate endurance, durability, maintainability, and structural life. Will evaluate manning schemes to determine optimum personnel requirements. In FY09, will refine flight characteristics and demonstrate air vehicle endurance, foot-print and turn time (time to prepare vehicle for next mission). Will demonstrate payload performance and data assimilation and storage. Will validate military utility of air vehicle in concert with ground control station and military operators.			5000	5000
Rotor Design & Capabilities: In FY08, will mature passive and active control methods for improving rotorcraft performance in a heavy vibration environment. Will initiate investigation to determine benefit, design implications and limitations of the Optimum Speed Rotor applied to rotorcraft of different classes and mission types. Will evaluate high lift technologies to provide rotor systems with improved aero performance, while enhancing damage tolerance. Will characterize advanced main rotor hub concepts compatible with on-blade rotor control systems leading to increased rotorcraft performance. Will evaluate applicability of candidate technologies to current airframes. In FY09, will characterize rotor system performance across the flight envelope, under a wide variety of flight conditions and mission types through rigorous flight testing. Will initiate the design of lightweight active rotor technology intended to improved aerodynamic efficiencies and maximize air vehicle performance. Will demonstrate enhanced rotor durability and performance technologies to assess contribution to aircraft maintenance and performance. Will mature leading concepts in passive and active technology arena to provide enhanced aerodynamic performance with optimized active and passive technology implementation.			17700	19708
Capability-Based Operations and Sustainment Technologies (COST): In FY08, will expand the existing engine diagnostic models to include continuous on-board power availability calculations, prognostic models, and advanced control models to allow the pilot to continuously know the engine power available for flight operations; to allow calculation of engine component efficiencies during flight to predict remaining life of components and scheduling of maintenance; and to enable the modification of the engine control laws to optimize performance based on the efficiencies of various engine modules/components. Will refine state-awareness algorithms for aircraft Center of Gravity (CG) and operating weight to enable accurate usage monitoring, thus preventing early retirement of components (as current component life is determined by an assumed worse-case application of CG and operating weight). Will integrate rotor/swash-plate bearing and hanger bearing algorithms into a health monitoring system. Will demonstrate fusion of sensor-based load and damage detection with prognostic algorithms to determine structural integrity. In FY09, will validate and refine engine algorithms by testing a turboshaft engine in a controlled, instrumented test cell. Will perform full-scale rig testing of rotor head and bearings to verify/validate the newly developed algorithms. Will initiate regression testing of software (which is when, during a bench test, the algorithms' functionality and interoperability with other software and sensor inputs is evaluated using simulated flight test data) in preparation for flight testing. Will demonstrate prognostication of remaining service life in damage tolerant airframe components.			6808	8707
Small Business Innovative Research/Small Business Technology Transfer Programs		814		
Total	27144	31173	42475	45726

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**	**435**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
435 AIRCRAFT WEAPONS	2765	3298	2908	3201	3744	2672		

A. Mission Description and Budget Item Justification: The Aircraft Weapons project matures and integrates manned and unmanned rotorcraft sensor and weaponization technologies for Future Force air-to-air and air-to-ground application and, where feasible, exploits opportunities to enhance Current Force capabilities. This project provides mature technologies to focus combat power on multiple targets. The technologies provide precision engagement capabilities to meet the demands of Military Operations in Urban Terrain (MOUT), force protection, and other asymmetrical threats. This project includes integration of advanced missiles, rockets, guns, fire control, advanced target acquisition and pilotage sensors, and directed energy weapons, including non-lethal capabilities onto existing and developing airframes. These capabilities are evaluated to assure compatibility and demonstrate timely, precision engagement capabilities and the full spectrum effectiveness of the manned and unmanned team. Technology integration issues concerning on-board systems, vehicle flight characteristics and weapon systems will be matured and demonstrated. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Aviation Applied Technology Directorate of the Aviation and Missile Research, Development, and Engineering Center located at Fort Eustis, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Weapons Integration: In FY06, matured Aerial Delivery of Effects from Lightweight Aircraft (ADELA) unmanned teaming and cueing efforts for collaborative engagements and participated in the Counter-Rockets, Artillery, and Mortar (C-RAM) demonstration using the Unmanned Little Bird (ULB) to acquire threats, send video imagery, and precise target coordinates into the force protection network to engage and destroy hostile forces. Demonstrated the integration of low cost sensors and weapons (0.338 cal rifle) on a Class III UAV to provide a precision engagement capability. In FY07, ADELA concludes with a tactical fire control, human-in-the-loop protocols and collaborative, team-based weapons and precision targeting demonstration to show how small UAVs can provide an airborne sniper capability in support of ground troops in a Military Operations in Urban Terrain (MOUT) environment. Address the application of directed energy (e.g., laser, radio frequency, acoustics) non-lethal weapons concepts to manned and unmanned aviation assets by maturing two contracts for concept refinement and platform integration analysis. In FY08, will complete system integration of the Directed Energy Non-Lethal effort. Will begin validating that weapons can provide sufficient vision dazzling effects, electronics, and optics disruption/destruction and/or generation of physical discomfort to be combat effective. In FY09, will refine system development and laboratory characterization. Will demonstrate a directed energy weapon to show that it is capable of providing platform defense and force protection by dispersing or incapacitating enemy personnel to the extent that the enemy cannot make an effective engagement. Will complete ground based field exercises to fully evaluate effects and range performance and to fully characterize the system. Will refine plans to integrate system onto a combat aviation platform.	2765	3217	2908	3201
Small Business Innovative Research/Small Business Technology Transfer Programs		81		
Total	2765	3298	2908	3201

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**	**447**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
447 ACFT DEMO ENGINES	7356	8284	8507	8688	9893	10262	10488	10718

A. Mission Description and Budget Item Justification: The Aircraft Demonstration Engines project matures and demonstrates power system technologies for use in the Future Force through competitively performed design, fabrication, and test of advanced material technologies, engines, and integrated components, and, wherever feasible, exploits opportunities to enhance Current Force turbine engines. This project supports the Future Force by providing mature technologies for lighter turbine engines that provide more power, can go farther, and are easier for the warfighter to maintain and sustain. These attributes improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. The Small Heavy Fuel Engine (SHFE) and Advanced Affordable Turbine Engine (AATE) efforts are fully aligned with the goals of the Department of Defense (DoD) Versatile Affordable Advanced Turbine Engine (VAATE) program. VAATE goals focus on reducing specific fuel consumption (SFC) and increasing the power-to-weight (P/W) ratio of turboshaft engines while decreasing production and maintenance costs. SHFE and AATE provide significantly increased range and payload capabilities for future manned and unmanned rotorcraft and sustainment upgrades for current engines. This includes significant Operation and Support cost savings and a significantly reduced logistics footprint. The SHFE effort focuses on maturing and demonstrating advanced, affordable turbine engine technology in the 700 horsepower (HP) class engine and AATE addresses needs in the 3000 HP class. The SHFE will result in significant improvements in SFC and P/W ratio that will enable a heavy fuel (JP-8) engine capability for applications such as the UAV Testbed, Armed Reconnaissance Helicopter (ARH), AH/MH-6 Mission Enhanced Little Bird, and other future ground and aerial vehicles. The AATE effort enables enhanced operational capability that is applicable to UH-60 Black hawk and AH-64 Apache. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Aviation Applied Technology Directorate of the Aviation and Missile Research, Development, and Engineering Center located at Fort Eustis, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
UAV Technology Demonstrations - Small Heavy Fuel (Turbine) Engine (SHFE): In FY06, completed Build 1A core and Build 1B engine testing; incorporated design improvements of the compressor, combustor, turbines, mechanical components, and control and accessories into Builds 2 and 3; completed the fabrication of redesigned components for engine Build 2; and conducted rig test on redesigned combustor and mechanical systems. In FY07, complete engine testing of Build 2 and rig test optimized components consisting of a combustor, controls, and associated mechanical systems; complete the fabrication of components for engine Build 3; and conduct final engine ground stand test for Build 3 to demonstrate program goal achievement.	7356	8073		
Advanced Affordable Turbine Engine (AATE) Tech: In FY08, will complete preliminary design, detailed design, and component fabrication of the initial build of an advanced 3000 horsepower-class turboshaft engine demonstrator, building on knowledge gained in the Small Heavy Fuel Engine effort, and the DOD Versatile Affordable Advanced Turbine engine effort. Design activity will include 2-D and 3-D mechanical and aerothermal efforts to evaluate the inlet particle separator, compressor, combustor, gas generator turbine, power turbine, bearings, seals, shafts, controls, and accessories. Fabrication efforts will include component hardware and rig support hardware for initial component rig tests. In FY09, will complete initial rig-tests for several engine components (e.g. compressor, turbine, combustor, mechanical systems) to validate design aerodynamic performance and mechanical integrity prior to integrating these technologies into a gas generator for a full engine test. Will use results from initial component rig-tests to complete / refine hardware fabrication efforts as appropriate for first engine build. Will analyze component rig-test results to support redesign efforts as required for			8507	8688

future engine builds.				
Small Business Innovative Research/Small Business Technology Transfer Programs		211		
Total	7356	8284	8507	8688

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	106558	92054	59389	74072	76675	79985	79677	81411
232	ADVANCED MUNITIONS DEM	45660	46149	31414	38245	39913	40296	34705	35332
43A	ADV WEAPONRY TECH DEMO	27262	22166						
L94	ELECTRIC GUN SYS DEMO	13863	13420	9571	11637	11887	13045	17742	18250
L96	HIGH ENERGY LASER TECHNOLOGY DEMO	4617	9298	17378	23157	23840	25609	26172	26748
L97	SMOKE AND OBSCURANTS ADVANCED TECHNOLOGY	959	1021	1026	1033	1035	1035	1058	1081
L98	HIGH EXPLOSIVE AIRBURST AMMUNITION AND WEAPONS SYS	14197							

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates advanced weapons and munitions technologies to increase battlefield lethality and survivability for the Future Force and, where possible, the Current Force. The goal of this program is to provide the warfighter with weapons and munitions that provide equivalent or greater lethality (or other desired effects) at greater ranges, with greater precision, in lighter weight systems and at affordable costs when compared to current weapon systems. Project 232 funds Mounted Combat System (MCS) and Abrams Ammunition System Technologies (MAAST), which provides enhanced capabilities beyond the baseline line-of-sight/beyond-line-of-sight (LOS/BLOS) armament and munition suite and matures the Mid Range Munition (MRM) to add an objective dual-mode hardened seeker for autonomous and designated engagement modes; Common Smart Submunition, which matures and demonstrates component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems; Fuze and Power for Advanced Munitions, which integrates enabling fuze technologies such as Micro-Electro-Mechanical Systems (MEMS), proximity sensors, Electronic Safe and Arm Devices (ESADs) and hybrid power systems in end item munitions for demonstration purposes; and Non-Lethal Payloads for Personnel Suppression, which designs and demonstrates the munitions to suppress activity or deny access to designated areas using non-lethal means. Project 43A funds congressional special interest items. Project L94 matures enabling technologies for an Electromagnetic (EM) Gun armament system that will lead to demonstrations of the key sub-systems in FY08. Based on successful completion of the component technologies, the Army will initiate an effort in FY09 for the design, fabrication, and test of an integrated EM armament demonstrator on a mobile platform. EM Gun has the potential to revolutionize the future battlefield with its unique performance characteristics, including hypervelocity lethality effects and greatly reduced logistics burden. Project L96 matures and demonstrates technologies that comprise a high energy, solid-state laser weapon. Project L97 matures and demonstrates smoke and obscurant technologies with potential to enhance personnel and platform survivability. Work in projects 232 and L94 is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology), PE 0602618A (Ballistics Technology). Work in project L96 is related to, and fully coordinated with, efforts in PE 0603005A/441 (Pulse Power for FCS) and PE 0602307/042 (High Energy Laser Technology). Work in this PE associated with project L97 is related to and fully coordinated with, efforts in PE 0602622A/A552 (Smoke/Novel Obscurant Munitions). Work in this PE is performed by the US Army Armament Research, Development, and Engineering Center (ARDEC), Picatinny, NJ, the Army Research Laboratory (ARL), Edgewood Chemical and Biological Center, Aberdeen Proving Ground, MD, and Space and Missile Defense Command Technology Center, Huntsville, AL. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	101841	74717	68495	78004
Current BES/President's Budget (FY 2008/2009)	106558	92054	59389	74072
Total Adjustments	4717	17337	-9106	-3932
Congressional Program Reductions		-4385		
Congressional Rescissions				
Congressional Increases		22400		
Reprogrammings	4717	-678		
SBIR/STTR Transfer				
Adjustments to Budget Years			-9106	-3932

FY08 funds decreased to fund higher priority Army efforts.

Twelve FY07 congressional adds totaling $21516 (after adjustment for Congressional Reductions) were added to this PE.

($2067) Armament Titanium Casting Advancement Program
($3453) Disruptive Technology Acceleration
($1923) Mid-Range Munition (MRM-KE)
($1923) National Nano Manufacturing Center (NNMC)
($959) Manufacturing of Precision Molded Aspheric Optics
($3460) Rapid Insertion of Development Technology
($959) Electromagnetic Gun Technology Maturation and Demo
($1295) Optical Processing Realization for Army Amaments
($1251) Production-class Nanoposder Processing Facility
($959) Reactive Nanocomposite Materials
($2308) Telepresent Rapid Aiming Platform (TRAP)
($959) Terramechanics Research to Reduce Vehicle Rollover

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**232**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
232 ADVANCED MUNITIONS DEM	45660	46149	31414	38245	39913	40296	34705	35332

A. Mission Description and Budget Item Justification: This project matures and demonstrates munitions enhancements and emerging technologies in lightweight structures, smart materials, acoustic/seismic sensors and in-flight update architectures that will enable equivalent or greater lethality (or other desired effects) at greater ranges, with greater precision, in lighter weight systems and at affordable costs when compared to current weapon systems. A major effort is the MCS and Abrams Ammunition System Technologies (MAAST). MAAST supports the maturation and demonstration of hardened dual mode seeker technology for Mid-Range Munition (MRM) (a gun launched precision munition for MCS capable of defeating high-value heavy armor and other targets out to 12km). The MAAST effort also matures technologies such as Low Cost Precision components and subsystems for command-guided projectiles, which will enhance the capabilities of the MCS and the M1A2 through spiral insertion and upgrades. This project also funds the Lightweight Dismounted Mortar Weapon, which is a man-transportable 81mm mortar fabricated from lightweight advanced materials and structures; Common Smart Submunition (CSS), which pursues critical subsystem evaluations leading to system demonstrations of a submunition that offers increased operational efficiency through multiple kills per munition, affords greater flexibility for carrier applications, and enables use of a variety of delivery systems; Non-Lethal Payloads for Personnel Suppression, which enables personnel suppression and area denial at BLOS ranges; Robotic and Network Technologies, which addresses various aspects of making armaments and munitions part of the networked battlespace; and Kinetic Energy Active Protection System (KEAPS), which develops munitions and countermeasures for Active Protection Systems (APS) to enhance survivability for lightly armored, or very lightweight vehicles. Other efforts in this project include: Fuze and Power for Advanced Munitions, which matures technologies that reduce munition sizes while adding tailorable effects to advanced munitions, and also improves advanced on-board munition power systems with increased power densities, increased mission time, improved temperature performance and reduced volume and weight; Countermine/Surface Laid and Buried Mine Neutralization which exploits Laser Induced Plasma Channel (LIPC) to defeat surface laid and buried mines; and Extended Area Protection and Survivability, which demonstrates the use of command-guided medium caliber projectiles for the interception and destruction of incoming rockets, artillery, and mortar rounds. Rheostatic Pulsed Energy Weapon System (RPEWS), which starts in FY08, will investigate weaponizing ultra short pulsed laser (USPL) / laser induced plasma channel (LIPC) onto a hybrid platform vehicle. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the Defense Technology Area Plan (DTAP). This work is performed by the US Army Armament Research, Development, and Engineering Center (ARDEC), Picatinny, NJ, in cooperation with the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD, and Tank, Automotive Research, Center (TARDEC), Detroit, MI.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
MAAST-MRM: In FY06, two concepts were matured for risk reduction purposes; also in FY06, continued integration of the semi-active laser (SAL) seeker, fabricated, assembled and High-G tested advanced seeker components, conducted hardware in the loop and captive flight tests for the SAL seeker, conducted two test series (4 shots total) of complex SAL guided shots in a designated-mode for guided engagement against a beyond-line-of-sight (BLOS) moving Russian T-72 Main Battle Tank; optimized software to improve tactical capabilities and conducted processor-in-the-loop and hardware-in-the-loop simulations for integrated dual-mode seeker. In FY07, complete fabrication and assembly of integrated dual-mode MRM target acquisition, guidance, and counter active protection systems; demonstrate gun-fired multi-mode MRM at a BLOS target. Efforts described here are coordinated and complimentary to related efforts in PE/project 0602624/H28.	10000	10000		

MAAST: In FY06, matured LOS-MP and iterated air-gun tests for fuze electronics, safe and arm hardware; designed, built and tested XM1157 fuze, verified electronics setter box for LOS-MP TRL6 demos; conducted LOS-MP TRL 6 demonstration vs. concrete wall (3 shots reduced g's, 3 shots, High-G); conducted LOS-MP TRL 6 demonstration vs. anti-personnel targets (3 shots reduced g's 3 shots, High-G); fabricated, assembled and conducted gun-fired demonstration of two-way ammunition data link which is applicable to all MCS ammunition types; and completed fabrication, assembly, and demonstration of integrated advanced propulsion capability with temperature compensation and precision ignition (2 propulsion demonstrations with surface coated double base (SCDB) propellant and hybrid propellants; for low cost precision (LCP) effort, down-selected lowest cost sub-component alternatives from two contractor concepts, completed initial designs and conducted component demonstrations that include a forward looking infrared (FLIR) demo, and component demos for yaw sonde, communications, thrusters, and software development for magnetometer sensor, complete design, fabrication, and ballistic demonstration of boosted maneuver capability for MRM KE concept, complete inertial measurement unit (IMU) development effort for in-flight shock mitigation, fabricate bench test, and complete ballistic demonstration of IMU capability in MRM-Chemical Energy(CE) concept. In FY07, fabricate, assemble, and demonstrate multi-function warhead for chemical energy munition for LOS-MP/MRM and demonstrate advanced propellant and robust cartridge case technologies; fabricate, assemble, and demonstrate in-flight tracking and maneuver control performance of projectile with LCP technologies.	16243	16044		
Lightweight Dismounted Mortar Weapon: In FY06, developed, tested, and ballistically demonstrated a lightweight full-scale prototype.	1875			
Pulsed Laser System Technologies: In FY08, will begin system trade study, system engineering and design for integration of the Ultra Short Pulsed Laser (USPL) / Laser Induced Plasma Channel (LIPC) to target acquisition/tracking sub-systems and potential platforms; begin long lead item procurements and test critical USPL components. The initial system configuration will be identified based upon power and energy versus size and weight requirements previously identified under the Countermine/IED Neutralization ATO and completed efforts in PE/project 0602624/H19. In FY09, fabricate and assemble USPL/LIPC and platform interface components; conduct subsystem testing and begin platform integration of the USPL / LIPC weapon components; conduct preliminary system demonstrations. Efforts described here are coordinated and complimentary to related efforts in PE/Project: 0602624/H19.			6225	6883
Ground Based Munitions Technologies: In FY09 initiate design of a ground based munition system capable of being delivered to a precise location once deployed from the primary delivery mechanism (e.g., MLRS, UAV, Fixed and Rotary wing, etc.). Current delivery systems allow for precise delivery to a specified point in space. Once that point is reached the payload is released and allowed to fall to the ground in a random pattern which may or may not be efficient in accomplishing the mission. This effort will be to provide a way to guide the components to the ground once released from the carrier and provide an effective pattern on the ground. As part of the effort, numerous means for providing maneuverability to an object in a free-fall state will be investigated. In addition a concept will be developed which will integrate technologies that will allow a system such as Intelligent Munitions System (IMS) to be emplaced on the ground with a precision that allows the system to be effective as designed. A demonstration of the maneuverability device will be done and a concept plan will be developed. Efforts described here are coordinated and complimentary to related efforts in PE/Project 0602624/H18.				3119
Scaleable Effect Weapon and Munition Systems: In FY08, will establish and evaluate baseline modeling of experimental hardware for evaluation of next generation explosives, reactive materials, and advanced liners. In FY09, will define and evaluate system selectability requirements to allow for controlled lethality against less-than-lethal, controlled lethal area, and extremely lethal target requirements. Will evaluate warhead tailoring methodologies to control munition energy output and will verify modeled scalablity effects in reduced munition sizes for man-portable classed systems. Will fabricate and test prototype hardware for evaluation of multipurpose capabilities.			3095	4932
Fuze and Power for Advanced Munitions: In FY06, conducted explosive safety testing of Micro-Electro-Mechanical Systems (MEMS) Safe and Arm (S&A) components and fabricated Electronic Safe and Arm Device (ESAD) components; evaluated performance of	956	4402	4750	

proximity and safety sensors in limited/simulated environmental. In FY07, continue explosive compatibility and safety tests of MEMs, demonstrate prototype battery designs in laboratory and conduct air gun high-g tests for new thermal and liquid reserve batteries and hybrid power systems; begin alternative/hybrid energy systems evaluations. In FY08, will integrate ESAD subsystem, will conduct demonstration of gun launched multipoint warhead initiation; will conduct performance testing of MEMS S&A device and MEMS impact switch performance in 155 mm projectile, will obtain Fuze Safety Review Board concurrence; For Sensors, will gun launch RADAR proximity fuze, will demonstrate proximity capability in direct fire application, will validate stand-off improvements and size reduction; will achieve lower power for LADAR configuration using advanced laser and detector; for Power, will demonstrate prototype organic chemistry based liquid reserve batteries and thermal management battery improvements with flight tests. Efforts described here are coordinated and complimentary to related efforts in PE/project(s): 0602624/H18, H19, and H28.				
Common Smart Submunition (CSS): In FY06, conducted tower test to characterize Laser RADAR (LADAR) sensor, signal processing, and recognition algorithms for detection, and discrimination of potential targets in dynamic environments. Codified registration algorithms for detecting and tracking up to three target Regions Of Interest (ROIs), evaluated performance in benign and degraded simulated conditions for algorithm consistency; drafted initial key feature extraction code build to registration; began drafting algorithm development plan for discrimination build. In FY07, mature sensor and algorithms for follow-on captive flight test (CFT) to achieve 0.95 probability of discriminating and firing at a target of interest; baseline Autonomous Target Recognition (ATR) performance and identify future iteration work building toward multi-target discrimination capability (Army, Air Force, Navy targets); provide test data for system analysis model and develop and validate a CSS system model for end-to-end simulation evaluation. In FY08, full up functional CSS prototype submunitions will be demonstrated (dropped) at the suspended cable facility at Sandia. LADAR/IR sensor and ATR discrimination algorithms will be verified in a dynamic Captive Carry Test (CCT). All ATR performance sub-sets such as registration, target detection, key feature extraction, and target recognition will be verified during CCT. Evaluations will serve as entrance criteria for System Design Review (SDR #2) and follow on efforts. Efforts described here are coordinated and complimentary to related efforts in PE/project(s): 0602624/H18, H19, and H28.	5737	7970	8703	
Non-Lethal Payloads for Personnel Suppression: In FY06, demonstrated kinetic energy mitigation of payload module, continued target effects analysis, and conducted system flight test demonstration. Efforts described here are coordinated and complimentary to related efforts in PE/project 0602624/H19.	1625			
Lightweight Cannon Integration: In FY09, will apply novel recoil attenuation techniques to large caliber weapons for future spirals of FCS weapon systems. This effort will lay the groundwork for the next generation of highly mobile cannon-based firing platforms with significantly enhanced firepower, i.e., the set of weapons beyond the current NLOS-C or MCS 120mm systems. This will be achieved by exploring RArefaction waVE guN (RAVEN) technologies, momentum cancellation techniques, and rapid fire initiatives.				6111
Advanced Power and Energy Management for Munitions: In FY09, will demonstrate nano-powders for use in MEMS fuzing components, initiate lab-validation of suitable fuel cell configurations for munition systems downselect; will prototype micro-scale igniter for thermal battery and optimize gun-hardened energy harvesting package.				2624
Dual Use Composites (DUC): In FY06, conducted Electronic G-Hardening and Electronic Fuzing for the Silent Operating Aerial Reconnaissance (SOAR) unmanned aerial vehicle (UAV). Began characterization tests of DUC material and built and provided demo for SOCOM Special Projects. In FY07, optimize DUC munition to increase accuracy and lethality through test demonstrations in an operational environment; develop most promising light weight solutions for remote weapon stations on robotic vehicle. Review current and developmental unmanned platforms which would benefit from DUC and provide enhanced technical knowledge of the DUC material through their complexity in design, and will increase the development of items high in fidelity and quality. In FY08, will optimize DUC	474	1081	1696	3535

munition to increase accuracy and lethality through test demonstrations in an operational environment; Future Force Gun and Munitions will mature most promising lightweight solutions for remote weapon platforms. Select one or two unmanned platforms from the candidates identified during FY07 and produce complex, high fidelity DUC components. In FY09, will optimize and integrate complex high fidelity DUC components into the unmanned platforms selected during FY08; demonstrate the quality, integrity and lethality through tests in an operational environment.				
Tunable Pyrotechnics: In FY08, will evaluate the efficacy of tunable pyrotechnic formulations by integrating and combining pyrophoric reactive materials, Nano Technology and pyrotechnic chemistry. The key process, product, and physical parameters will be evaluated. In FY09, will use the successful candidate formulations and conduct energetic characterization, sensitivity studies, and initial prototype application for counter measures and battle field effects simulators.			1032	2891
Countermine/Surface Laid and Buried Mine Neutralization: In FY07, integrate directed energy power source technologies onto a ruggedized skid to demonstrate and assess the feasibility of further maturing and developing this technology for mine destruction. Efforts described here are coordinated and complimentary to related efforts in PE/project 0602624/H19.		1920		
Extended Area Protection and Survivability (EAPS): In FY06, analyzed and modeled gun-based concepts for a gun-based air defense capability against rockets, artillery, and mortar rounds (RAM) to establish an appropriate caliber, firing rate, and kill mechanism; defined gun-based system requirements and component technology specifications. In FY07, integrate advanced warhead and fuze configurations within the EAPS projectile; and conduct live fire demonstrations to validate lethality against static RAM targets. In FY08, will evaluate an integrated design based on results of "A" and "B" round developments and demonstration firings. Efforts described here are coordinated and complimentary to related efforts in PE/project 0602624/H28.	1482	1516	2813	
Unguided Multiple Explosively Formed Penetrator (MEFP) Warhead (Kinetic Energy Active Protection System (KE-APS)): In FY06, fabricated objective Optical Transceiver Module (OTM). Conducted threat detection verification lab test of the OTM against Kinetic Energy (KE) and High Explosive (HE) threats. Fabricated full-up objective Optical Proximity Fuze (OPF) for unguided KE-APS interceptor. Conducted Spinning BrassBoard Sensor test (SBBST) with live, fly-by KE and HE threats to verify fuze functionality. Conducted MEFP Warhead characterization tests. Designed, fabricated, and tested Objective MEFP Warhead (series#1).	6556			
Future Force Gun and Munition Technology (Lightweight Armaments Enhancement Program): In FY06, matured technologies to improve cannon performance and reduce overall weight including: novel muzzle brake/blast deflector, dual autofrettage process, and a lightweight recoil system recuperator. Supported integration of ARL-developed technology into 120mm XM360 gun to significantly increase accuracy and probability of hit (Ph) with FCS weapons.	712			
Military Operations in Urban Terrain (MOUT)/Urban Lethality Technologies: In FY07, will develop multi-mode, high-blast/anti-armor designs for single warhead configurations and will develop the forward break-in charge designs for tandem configurations. Designs will be used for modeling and fabrication of prototype warheads for experimental validation in FY08. In FY08, will conduct initial modeling and experimental validation of multimode warhead design concepts and fuze requirements for shoulder launched munitions and will mature and evaluate linear shaped charge liner and multipoint initiation designs for a light weight wall breaching system. In FY09, will evaluate advanced fuzing options of multimodal warheads on shoulder launched platforms and will optimize liner and initiation concepts for system integration and conduct wall breach demonstration testing; conduct testing of Kinetic Energy Active Protection System launchers.		2000	3100	8150
Small Business Innovative Research/Small Business Technology Transfer Programs		1216		
Total	45660	46149	31414	38245

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**L94**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
L94	ELECTRIC GUN SYS DEMO	13863	13420	9571	11637	11887	13045	17742	18250

A. Mission Description and Budget Item Justification: This project matures and demonstrates Electromagnetic (EM) armament subsystems and the enabling technologies for tactically relevant EM launchers, pulsed power and launch packages (projectiles). EM Guns have the potential to revolutionize the future battlefield by their unique performance characteristics (hypervelocity and reduced-signature launch), potential for elimination of vulnerable propellants, synergistic relationship with hybrid electric vehicles, and potential for significant reduction in sustainment burden. In addition to designing, fabricating, and demonstrating subsystem components, the project resolves system level technology challenges including synchronization/compatibility of twin counter-rotating machines, technology scalability, thermal management, and full energy system performance. After successful demonstration of the critical components and subsystems at tactical scale, an Advanced Technology Demonstration (ATD) effort will be conducted to integrate next generation subsystems into a stand-alone medium caliber armament prototype, comprising robust launcher, pulsed power supply, launch packages, prime power, cooling and auxiliaries, to demonstrate system performance. In FY06, the Kinetic Energy Active Protection System (KEAPS) effort complements work in project 232 that focuses on maturing and demonstrating effectiveness of munitions associated with Active Protection Systems. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the Defense Technology Area Plan (DTAP). This project is executed by the Armaments Research, Development, and Engineering Center (ARDEC) at Picatinny, NJ, in cooperation with the Army Research Laboratory (ARL), Adelphi, MD, and The University of Texas at Austin (a University Affiliated Research Center). This work complements and is fully coordinated with efforts in PE/project(s) 0602618A/H75 and PE0601104A/H56.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
EM Gun System Demonstration: In FY06, conducted rail gun manufacturing validation trials, completed subsystem interface requirements, and fabricated half-length, full-caliber version of threshold launcher design for range testing; performed fuze functionality tests and demonstrated the launchability of high-explosive (HE) projectiles in an EM armament environment; fabricated breadboard Pulsed Power Supply (PPS) components, demonstrated critical rotating machine sub-assembly over full operational speed, and conducted verification testing of PPS switch stacks. In FY07, complete fabrication of a partially cantilevered railgun test bed and demonstrate strength of design and scaling effects testing at full scale launch peak loading conditions; test fire an integrated HE, fuzed launch package from a laboratory EM gun; complete acceptance/verification testing of PPS sub-assemblies, manufacture and test the two rotating machines. In FY08, will build a lightweight cantilevered high fidelity railgun with integrated breech and muzzle shunt and demonstrate objective performance at hypervelocity and multi-round launchability; will integrate the compact, twin counter-rotating pulsed alternator power supply, conduct subsystem functional tests and accomplish high fidelity breadboard PPS demonstrations that will establish and validate requisite performance criteria. In FY09, will build upon the test beds to mature next generation EM armament subsystem hardware; will prepare point-of-departure performance specifications to support evolutionary concepts for an integrated, mobile demonstrator platform selected on best balance of technical difficulty and military utility; will generate preliminary designs, conduct flow-down risk analysis, and assess the fidelity of gun launcher, pulsed power, and launch package components/subsystems; will establish system level functionality through physics based models and end-to-end performance simulations.	13863	13074	9571	11637
Small Business Innovative Research/Small Business Technology Transfer Programs		346		
Total	13863	13420	9571	11637

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**L96**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
L96	HIGH ENERGY LASER TECHNOLOGY DEMO	4617	9298	17378	23157	23840	25609	26172	26748

A. Mission Description and Budget Item Justification: This project matures and demonstrates advanced technologies for Future Force High Energy Laser (HEL) weapons technology, and, where feasible, exploits opportunities to enhance Current Force capabilities. The major effort under this project is the development of a mobile one-hundred kilowatt (kW) class Solid State High Energy Laser Technology Demonstrator (HELTD) that is traceable to the form, fit, and function requirements of the Future Force. HEL systems have the potential to address the following identified Army capability gaps: 1) Defeat In-Flight Projectiles such as rockets, artillery, mortars, anti-tank guided missiles, and man-portable surface-to-air missiles; 2) Ultra-Precision Strike with little to no collateral damage; 3) Disruption of Electro-Optical (EO) and Infra-Red (IR) sensors; and 4) Neutralizing surface-laid mines and other ordnance from a stand-off distance. HELTD possesses the characteristics required to support future Joint / Army requirements for a lethal capability that is deployable, mobile, self-sustaining, while capable of operating in a full spectrum, networked, information-based battlefield environment. HELs are expected to complement conventional offensive and defensive weapons at a lower cost-per-shot than current systems. The HELTD program utilizes a modular building block approach with open systems architecture to ensure growth and interoperability. This modular approach ensures opportunity for technology insertions for maturation of laser, beam control, sensor/radar, integration of power (pulsed), and Battle Management Command, Control, and Computers (BMC3) to support the Current / Future Force. At weapon system power levels of around 100kW, Solid State Laser (SSL) technology has the potential to enhance survivability by addressing the capability gaps identified above. The SSL technology effort in PE 0602307A addresses technical issues such as high average power output from compact and more efficient lasers; precision optical pointing and tracking; laser effects degradation due to atmospheric effects; lethality against a variety of targets; and effectiveness against low-cost laser countermeasures. This program will use and integrate the Pulse Power Supply developed in PE 0603005A scheduled for completion in FY08 and available for integration in FY09. The supporting effort under this project is the development of a Force Encampment Protection System (FEPS) radar designed to detect, track, discriminate, and predict impact / launch points of rockets, artillery, and mortars (RAM) launched from any direction. It meets the demanding 360 degree, short-timeline search requirements imposed by rockets fired directly into defended encampments on depressed trajectories. A novel three-tier antenna configuration enables fast horizon searches as well as track of targets up to 80 degrees elevation, providing near hemispherical radar coverage at a fraction of the cost of a conventional phased array antennas. The FEPS radar will be capable of providing a highly-accurate and reliable sense and warn capability. In order to accomplish this mission, FEPS will have the capability to detect, discriminate, provide impact, and launch point prediction on RAM threats. It also will provide precision track data to directed energy and kinetic energy munitions used to intercept these targets. There are currently no sensors that provide this total capability. The Counter-Rocket, Artillery, and Mortar (C-RAM) program office has identified the FEPS radar technology as key in filling a gap in the search, track, discrimination, and impact point prediction of RAM targets. Work in this project is related to, and fully coordinated with, efforts in PE 0602307A, PE 0602890 D8Z, PE 0603005A, and PE 0603924D8Z (High Energy Laser Joint Technology Office), PE 0605605A (DOD High Energy Laser Systems Test Facility), and PE 0603005A/441 (Combat Vehicle and Automotive Advanced Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by Aberdeen Proving Ground, MD, and US Army Space and Missile Defense Command Technical Center, Huntsville, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
High Energy Laser Technology Demonstrator (HELTD): In FY06, initiated SSL weapon system studies based on the 100kW SSL	2667	6435	17378	23157

laboratory devices being developed in PE 0602307A to derive demonstrator technical performance specifications and assess the capabilities of the existing Air Defense target acquisition and Command, Control, Computers, and Intelligence (C3I) capabilities to meet the directed energy weapon specifications. Began preliminary systems engineering analysis and design of a target acquisition and tracking system component with hemispherical coverage that meets precision handover requirements for the HELTD and conducted subscale testing of critical subcomponents and materials to validate the design. In FY07, initiate HELTD subcomponent development with interfaces for items such as the beam control system that incorporates technologies to improve pointing accuracy and minimize jitter to enable improved energy deposition on target at the SSL wavelengths. This includes defining detailed beam control system requirements, conducting design to capabilities trades, and initiating some long lead item procurements. In FY08, will continue fabrication and assembly of the beam control system and design ruggedized versions of the laser components, will initiate Systems Engineering efforts and develop detailed Systems Requirements for the HELTD, will develop detailed interface requirements, and will continue subcomponent development of target acquisition and tracking system. In FY 09, will complete development of the beam control system and begin testing, fabricate the ruggedized laser, and complete the Systems Engineering effort producing a HELTD System Concept (System Functional Review). Will initiate the system integration effort, based on the selected SSL technology and beam control system, through design trades and long lead item procurements and will complete development and initiate prototype testing of target acquisition and tracking system.				
Force Encampment Protection System (FEPS) radar program: In FY06, completed initial design of antenna and switching components; completed design and development of molds for plastic components and Rotman lens; and initiated testing of plastic components for expansion, thermal conductivity and metal plating. Initiated agreement with Massachusetts Institute of Technology / Lincoln Laboratories to test high power components in the Haystack radar facility. Developed test plans for high power testing. In FY07, continue to develop primary Ku-band antenna components, Rotman lens, slotted waveguide radiators, and interconnecting waveguide pieces manufactured from plated plastic. Develop antenna slotted waveguide emitter design and a prototype receiver capable of receiving signals from up to four channels. Develop two elements of the radar array and perform high power, heat dissipation and monopulse tracking tests. At the end of FY07 this program will transition to the US Army Aviation Missile Research, Development, and Engineering Center (AMRDEC) as part of the C-RAM tracking and fire control effort in PE 0603313A.	1950	2600		
Small Business Innovative Research/Small Business Technology Transfer Programs		263		
Total	4617	9298	17378	23157

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**L97**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
L97	SMOKE AND OBSCURANTS ADVANCED TECHNOLOGY	959	1021	1026	1033	1035	1035	1058	1081

A. Mission Description and Budget Item Justification: This project matures and demonstrates smoke and obscurant technologies with potential to enhance personnel/platform survivability by degrading threat force surveillance sensors and defeating the enemy's target acquisition devices, missile guidance, and directed energy weapons. Dissemination systems for new and improved obscurants are developed with the goal of providing efficient and safe screening of deployed forces. A major effort will demonstrate the dissemination of newly developed advanced infra-red (IR) obscurants having four times the previous performance. Modeling and simulation tools developed in PE 0602622A will be matured to predict performance and analyze strategic use of obscurants on the battlefield. Other efforts mature dissemination, delivery, and vehicle obscurant enabling technology with potential to increase survivability through increased standoff and threat protection. After successful demonstration, these technologies transition to the Family of Tactical Obscuration Devices, and other System Development and Demonstration programs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Edgewood Chemical Biological Center, Edgewood, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Obscurant Enabling technologies: In FY06, developed mature concepts for prototype systems for use in grenades, artillery rounds, and other smoke generating systems; identified techniques for field evaluation of prototype dissemination systems. In FY07, refine design of prototype packaging/dissemination concepts; develop prototype system for advanced IR obscurant. Conduct experiments of new dissemination techniques in a relevant operational environment. In FY08 will mature, fabricate, and test the selected grenade concept as necessary to meet TRL-6 prototype requirements. In FY09, will evaluate dissemination methods and will conduct modeling and analysis of advanced IR obscurants for artillery and mortar applications.	959	992	1026	1033
Small Business Innovative Research/Small Business Technology Transfer Programs		29		
Total	959	1021	1026	1033

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	212115	204383	131436	108554	86386	85799	84206	86004
221	COMBAT VEH SURVIVABLTY	17726	20484	45414	37659	22185	22938	25507	26089
441	COMBAT VEHICLE MOBILTY	36789	34199	43876	40399	45818	44078	39587	40466
497	COMBAT VEHICLE ELECTRO	8609	9564	13110	7500	7643	7763	7934	8108
515	ROBOTIC GROUND SYSTEMS	12221	17391	9484	10248	10390	11020	11178	11341
533	Ground Vehicle Demonstrations	35757	47124						
53D	NAC Demonstration Initiatives (CA)	63922	53009						
53G	FUTURE COMBAT SYSTEMS (FCS)	34445	20563	14215	12069				
C66	DC66	2646	2049	5337	679	350			

A. Mission Description and Budget Item Justification: The Army vision demands a force that is deployable, agile, versatile, lethal, survivable, and sustainable across the spectrum of operations. The goal of this program element (PE) is to mature and demonstrate leap-ahead combat vehicle automotive technologies to enable transformation to the Future Force and, where possible, to exploit opportunities to enhance Current Force vehicle-related capabilities. Army S&T continues to play an important role for the Future Force vehicles by providing critical technology solutions and spiral opportunities. A significant portion of the FY06-FY07 funding supports the collaborative Army/Defense Advanced Research Projects Agency (DARPA) FCS Enabling Technologies efforts (project 53G). Memoranda of Agreement (MOA) between the Army and DARPA delineate the collaborative enabling technology efforts, the cost-shared funding profile, and responsibilities associated with this partnership. In addition, this PE supports maturation and demonstration of enabling component technologies in the areas of survivability (project 221), mobility (project 441), combat vehicle electronics (project 497) and robotic ground systems (project 515). These advanced technologies are demonstrated in coordination with Army Acquisition Project Managers and warfighter organizations through vehicle component and system level technology demonstrations. Project 221 matures and demonstrates survivability technologies including advanced armors, Active Protection Systems (APS), and safety devices. Beginning in FY07, a major effort is TWV Survivability, which focuses on maturing and demonstrating viable integrated survivability suites that can be tailored to meet current and future threats when applied to light, medium or heavy tactical vehicles. This effort will provide essential underpinning data to support the mutual effort between the Army and Marines for the next generation Light Tactical Vehicle. While demands for more platform power increase to meet the challenges of network centricity and assured operations, there is also an increased challenge to reduce fuel consumption and increase energy efficiency. Power/energy component and hybrid electric vehicle (HEV) technologies, which can provide power for propulsion, control systems, communications, life support systems, electric weapons, and protection systems, are key enablers for enhancing Current Force and Future Force capabilities. In the near term project 441 focuses on evaluating and demonstrating the maturity of HEVs for military applications and on demonstrating the associated performance benefits and burdens through experimentation and testing against relevant tactical mission duty cycles and environments. Over the longer term, the project focuses on advancing component energy density and system efficiency, while increasing platform capability. Project 441 also demonstrates critical power, propulsion and electric systems including energy storage, power distribution, and Pulse Forming Networks (PFNs). In the mid term Pulse Power technology focuses on enabling Electromagnetic (EM) armor. Over the longer term, this effort focuses on accommodating advanced electric weapons (lasers, high power microwaves, and EM guns) and advanced electric-based protection systems. Project 497 focuses on maturing technologies that enable Soldiers and robotic systems to fight side-by-side. The Robotics Collaboration effort pursues technologies for human-robot interaction in Soldier-robot teams such as: intelligent agents, adaptive automation, augmented

reality for increased local situational awareness, and user-friendly displays to reduce the Soldier's burden in the control of manned and unmanned ground and air systems. In addition, project 515 includes the Near Autonomous Unmanned Systems effort which matures and demonstrates technologies to enable robotic vehicles to act more independently during tactical maneuvers and protect themselves from intruders, thereby enabling the Soldier to perform other mission tasks. Projects 533 and 53D fund congressional special interest items. Project C66 supports programs that are classified. Work in this program element (PE) is related to, and fully coordinated with, PE 0602601A (Combat Vehicle and Automotive Technology) and 0602618 (Ballistics Technology). Work in this PE is coordinated with the US Marine Corps, the Naval Surface Warfare Center, the Naval Research Laboratory, Air Force Armaments Command, and other ground vehicle developers within the Departments of Energy, Commerce, and Transportation as well as DARPA. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP) and the Army's Tactical Wheeled Vehicle Fleet Modernization Strategy. Work in this PE is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	242013	109952	124336	96592
Current BES/President's Budget (FY 2008/2009)	212115	204383	131436	108554
Total Adjustments	-29898	94431	7100	11962
Congressional Program Reductions		-5319		
Congressional Rescissions				
Congressional Increases		101250		
Reprogrammings	-29898	-1500		
SBIR/STTR Transfer				
Adjustments to Budget Years			7100	11962

FY06 funds decreased to support higher priority efforts.

Fifty FY07 congressional adds totaling $97045 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1247) Tactical Vehicle Design Tools
($1965) Aluminum Lightweight Structures Initiative (ALSI)
($1295) Pacific Rim Corrosian Research Program
($1726) Armored Composite Cab Development
($1151) Lightweight Diesel Engine for Ground Vehicles
($3835) Ltwgt Comp Armor for Blast & Ballistic Protection
($3115) 3-D Advanced Battery Technology (3-D ABT)
($958) Advanced Lightweight Composite Armor
($1917) Antiballistic Windshield Armor (AWA)
($2875) Army Tactical RPG Airbag Protection System (TRAPS)
($958) Battery System Development
($958) Center for Innovative Materials Research (CIMR)
($1246) Cross Cue APS Radar
($1917) Fire Resistant Fuels
($1869) Heat Dissipation for Electr Systems & Enclosures
($3450) High Speed Desel Combustion
($958) LEAN Digital Product Development
($1869) Light Weight Armor Ready Composite Cab
($958) Light Weight Medium Tactical Trailer

($958) Mobile Armor Plant: Battlefild Expedient Armor Mfg
($2300) Purpose Built Armored Tractor Test and Evaluation
($6230) Unmanned Ground Vehicle iInitiative
($958) UGV/UAV Collaborative Operations
($958) Vehicle Information Manager Display for Drivers
($2876) Advanced Thermal Management System
($2301) Battery Charging Technology
($1869) Digital Humans & Virtual Reality
($1630) Dev of Logistical Fuel Processors for TARDEC/TACOM
($3738) Fuel Cell Ground Spt Equipment Demos
($1246) Secure Pervasive Computing for Adv Cbt Vehicles
($1869) Next Gen Non-Tactical Vehicle Propulsion
($1438) Adv Drivetrains for Enhanced Mobility and Safety
($3451) Amphibious Personal Mobility Vehicle
($7764) Center for Military Vehicle Technologies
($958) HAZ-MAT Material Vacuum System
($1246) Solid Oxide Fuel Cell Materials & Manufacturing
($1102) Advanced Tactical Vehicle Safety and Reliability
($1534) Alt Fuels Validation Prog/Military Ground Vehicles
($1390) Battlefield Requirements Management Support System
($958) Compressible Magneto-Rheological (CMR) Fluids
($2971) High Speed Machining of Ceramics for Military Apps
($958) HMMWV Equipment Innovations in Lighting and Towing
($958) Lightweight Road Wheels
($2875) Low Quantity Precision Fabrication
($1198) Mobile Info Distrib & Access-Control Sys (MIDAS)
($958) National Center for Titanium Machining
($958) Segmented Band Track Technology
($1246) Tactical Vehicle Fleet Management
($1390) Vehicle Maintenance Prognostics System
($2492) Versatile Utility Vehicle

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**221**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
221 COMBAT VEH SURVIVABLTY	17726	20484	45414	37659	22185	22938	25507	26089

A. Mission Description and Budget Item Justification: This project matures and demonstrates combat vehicle survivability technologies essential for the Future Force as well as provides technical solutions for enhancing the survivability capabilities of the Current Force. Focus is on advanced armors, Active Protection Systems (APS), safety devices, and integration of these onto Future Force vehicles, Future Tactical Wheeled Vehicles (TWVs) and, where practical, Current Force combat and tactical vehicles. As combat vehicle systems become smaller and lighter and tactical vehicles are more often exposed to combat conditions, one of the greatest technological and operational challenges is providing adequate crew protection without reliance on heavy passive armor. These challenges are being addressed by major efforts in integrated survivability suites comprised of APS coupled with advanced ballistic protection which provides electromagnetic (EM) armor, smart and ceramic armors integrated with advanced composite and laminate structures, and advanced transparent armor formulations. The APS against Kinetic Energy (KE) threats effort conducts essential trade studies, technical evaluations, and demonstrations of APS components/sub-systems including countermeasure warheads and interceptors, detectors, and trackers, and fire control hardware and software required to identify, classify, and defeat KE threats as defined for Future Combat Systems (FCS). Technologies and performance data are transitioned for use in Future Force manned ground vehicles and potential spin-offs to Current Force combat vehicles. This effort is integrated and coordinated with efforts from program elements (PEs) 0602624A (Weapons and Munitions Technology), 0603004A (Weapons and Munitions Advanced Technology), and 060313A (Missile and Rocket Advanced Technology). TWV Survivability focuses on maturing and demonstrating viable integrated survivability suites that can be tailored to meet current and future threats when applied to light, medium, or heavy tactical wheeled vehicles. This effort provides essential underpinning data to support the mutual effort between the Army and Marines for the next generation Light Tactical Vehicle. Lightweight, integrated armor technologies, using components from Program Elements (PEs) 0602601A (Combat Vehicle and Automotive Technology), 0602618A (Ballistics Technology), and 0602105A (Materials Technology), are integrated and demonstrated through ballistic testing to validate performance versus weight against various armor protection requirements. AP systems and signature management treatments are also be integrated and evaluated to determine effectiveness and ability to counter threats in conjunction with armor treatments. Data will be provided to the Program Manager (PM) for Future Tactical Systems (FTS) as input to Technology Readiness Assessment for their next generation Light Tactical Vehicle . Modeling tools that characterize hardware performance of the survivability enhancements are matured and validated and linked to tactical vehicle virtual prototyping tools, enabling more rapid and cost effective adaptations and evaluations of effectiveness in the future. The goal of the Vision Protection effort is to mature and demonstrate treatments to optical systems that provide protection from frequency-agile laser weapons. These technologies are appropriate for transition to Future Force vehicles for spiral integration or to Current Force vehicles such as the Abrams, Bradley, and Stryker. Work in this PE is related to and closely coordinated with work conducted in PE 0602601A (Combat Vehicle and Automotive Technology) and in collaboration with the Army Research Laboratory's PE 0602618A (Ballistics Technologies) as well as with the US Marine Corps and Office of Naval Research. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, the Defense Technology Area Plan (DTAP), and the Army's TWV Fleet Modernization Strategy. Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI; Army Research Laboratory (ARL), Aberdeen Proving Ground, MD; and US Army Armaments Research, Development, and Engineering Center (ARDEC), Picatinny, NJ, and the US Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
APS against close-in threats (Full Spectrum Active Protection Close In Layered Shield (FCLAS)): In FY06, demonstrated FCLAS on a	3600			

both a static and moving HMMWV and evaluated performance; analyzed FCLAS application to rotorcraft and alternate launch mechanisms.				
APS against KE: In FY06, performed system engineering technical trade studies and engineering modeling; conducted test firings of critical components; assessed tracking radar, interceptor, and countermeasure assemblies against tank fired Kinetic Energy (KE) threats; characterized kill radius and warhead effects associated with various candidate system approaches; evaluated and performed engineering tests on high risk KE sensors, fuses, and warheads. In FY07, work with AMRDEC to initiate preliminary design of KE-APS interceptor designs, conduct analysis of interceptor guidance options and downselect guidance scheme and develop detailed design of KE interceptor. In addition, work in concert with ARDEC to mature and characterize blast warhead capable of defeating KE threats and develop and the fuse capable of reacting fast enough to engage hypervelocity threats; develop Systems Engineering Plan (SEP), Test and Evaluation Master Plan (TEMP), systems architecture, initial system and component specifications, and interfaces. In FY08, will provide design support to integrate S&T developed components into FCS vehicle architecture and hardware for the KE AP system; work in concert with ARDEC to weaponize/integrate the warhead and fuse package and begin integration with interceptor being developed at AMRDEC; update the SEP, the TEMP, systems architecture, system and component specifications and interfaces; coordinate and manage and conduct KE APS component testing of warhead, fuze, and interceptor to meet FCS timelines. In FY09, will complete system and component specifications; finalize all system interfaces. Work with ARDEC to complete warhead weaponization & fuse package and integrate into interceptor; build and test warheads in support of KE APS final demonstration; coordinate transition of components for integration into future combat vehicles; and work with AMRDEC to conduct/participate in KE APS interceptor/system testing, demonstration, and analysis.	11326	8658	18461	13876
TWV Survivability: In FY07, use modeling and simulation tools to conduct trade studies and analyses to identify viable candidate integrated survivability suites for one or more TWVs; mature selected safety equipment and APS components and validate ballistic performance, structural capability, and durability of components; assess manufacturability and affordability of candidate solutions; select "best mix" survivability suite for initial demonstration; provide results of assessments and data from performance tests to PM FTS in support of Technology Readiness Assessment. In FY08, will finalize component maturation and fabricate demonstration vehicle(s) while continuing integrated suite design activities and will conduct studies with experimentation to determine the impact of various survivability suites on vehicle weight, volume, and power system. In FY09, will conduct extensive experiments and tests of several integrated survivability suites on demonstration vehicle(s) to verify and validate the level of protection achieved, the durability of the systems and the impact of the added weight, volume, and power on vehicle performance.		6258	11928	10976
Vision Protection: In FY06, developed designs to meet targeting requirements of the electro-optic vision system and demonstrated materials that provide various amounts of protection from laser damage. In FY07, integrate and evaluate nonlinear optical materials that protect the sensors from laser-induced damage; begin construction of a breadboard targeting system using these concepts; and begin design of laser-protected FCS navigation camera system and optical fire control. In FY08, will complete and test the fire control camera breadboard for optical and laser protection performance and fabricate protection system for navigation camera. In FY09, will complete and test agile laser protection in FCS-type navigation camera and optical fire control breadboards.	2800	2824	5556	3823
Armor/Mine Protection: In FY07, investigate lighter weight/more efficient/novel protection technologies in the areas of opaque armor, transparent armor, close-in Rocket Propelled Grenade (RPG) protection, and mine protection for Tactical Wheeled and Combat Vehicles; pursue near-term armor design options to provide increased protection against small arms, surface laid, and buried mines, fragment and Explosively Formed Penetrator (EFP) threats, defeat of close-in RPGs and design guidance for increasing Light Tactical Vehicle (LTV) mine protection; develop initial vehicle-level mine response modeling and simulation (M&S) capability to support vehicle trade studies. In FY08, will mature near-term opaque/transparent/RPG armor designs and develop design guidance for future Medium Tactical and		2481	9469	8984

Combat Vehicles mine protection; will demonstrate initial mine kit designs; will develop and demonstrate candidate spin-out armor/transparent armor/RPG protection; will further develop vehicle-level mine response M&S to include vehicle kinematics response. In FY09, will continue to develop lighter weight armor/mine protection solutions with an emphasis on meeting objective threat defeat levels at reduced weights; will develop design guidance for future Heavy Tactical Vehicles (HTV) mine protection; will demonstrate improved mine kit designs and will further develop vehicle-level mine response M&S to include crew/occupant response.				
Small Business Innovative Research/Small Business Technology Transfer Programs.		263		
Total	17726	20484	45414	37659

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**441**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
441 COMBAT VEHICLE MOBILTY	36789	34199	43876	40399	45818	44078	39587	40466

A. Mission Description and Budget Item Justification: This project matures and demonstrates advanced mobility and electric component and subsystem technologies for next generation ground combat and tactical vehicles and provides demonstrations of increased vehicle performance and capability. It enables lightweight, agile, deployable, fuel efficient, and survivable ground vehicles needed for the Future Force and enhancements to the Current Force. It demonstrates critical propulsion, power, and electrical components and subsystems (advanced engines, lightweight track, energy storage devices, power distribution systems, Pulse Forming Networks (PFNs), and components/subsystems needed to employ alternative fuels) for combat and tactical vehicles. Power/energy component and Hybrid Electric Vehicle (HEV) technologies, which can provide power for propulsion, control systems, communications, life support systems, electric weapons, and protection systems, are key enablers for enhancing capabilities. In the near term a major focus is on evaluating and demonstrating the maturity of HEVs for military applications and on demonstrating the HEV performance benefits and burdens through experimentation and testing against relevant duty cycles and environments in a Power and Energy Systems Integration Laboratory (P&E SIL) and at instrumented test tracks. Over the longer term, the efforts focus advances component energy density and system efficiency while increasing platform capability. The P&E SIL is a reconfigurable hardware-in-the-loop experimentation facility that replicates vehicle power and performance characteristics in a simulated system representing military HEVs (including power distribution and storage systems, traction motors, active suspension, high-density capacitors and pulse power components, and high-temperature silicon (Si)/silicon carbide (SiC) electronics). The HEV Propulsion effort matures components and sub-systems and demonstrates them in the P&E SIL, which,in the near term, is configured to support HEV designs. The effort also supports development of mission duty cycle profiles critical to evaluations of ground vehicle HEV technologies. The HEV Experimentation and Assessment effort analyzes differences between the demands of commercial, civilian operating environments, and the military operating environments, determines the impact of these differences on the performance of various HEV designs and architectures, evaluates and demonstrates the maturity of HEVs for military applications, and develops modeling and simulation tools that may be used to predict drive cycle fuel economy and performance characteristics (primarily fuel economy but also acceleration, speed, reliability, maintainability, tractive power, and ability to maintain speed on grade) for tactical platforms. The Advanced HEV Components effort seeks significant increases in next generation combat and tactical vehicle mobility, efficiency, and mission capability without increasing vehicle weight and volume through the maturation and demonstration of advanced traction wheel motors, active suspension, high temperature electronic components, regenerative brakes, thermal management, lightweight track, and segmented band track. New designs and packaging concepts are matured and validated in component testing to verify improved performance, reliability, durability. The Pulse Power effort matures component technologies and demonstrates compact components and subsystems that enable revolutionary survivability and lethality applications. The goal is to make significant advances in the maturity of high power density, capacitor-based PFNs that enable advanced electromagnetic (EM) armor, and advanced electric weapons for FCS spiral insertions. The High Power Engine Research (HIPER) effort matures and demonstrates prime power (engine) components and concepts with a goal to more than double the power density (horsepower per cubic foot (hp/cu.ft.)) of currently fielded combat engines and raise the state-of-the-art from 6 hp/cu.ft to 8-10 hp/cu.ft. The Advanced Lightweight Track effort develops new segmented band track and hybrid steel track technologies that are robust, lightweight, exhibit low vibration and acoustic emissions, reduce crew maintenance, and are field supportable. The JP-8 Reformation for Fuel Cells effort matures reformer and desulphurization technologies, which convert battlefield fuels to the hydrogen required for fuel cell operation. This enables fuel cells to be practical for military vehicle power generation. The Fuel Efficiency ground vehicle Demonstrator (FED) is a new effort focused on demonstrating the viability of achieving significant decreases in fuel consumption, without sacrificing the performance or capability, in a tactical vehicle by integrating potentially high-payoff fuel efficient technologies and advanced lightweight materials in new and innovative designs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, in conjunction with Army Research Laboratory (ARL),

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
HEV Propulsion and P&E SIL: In FY06, evaluated emerging novel hybrid electronics components and integrated them within the P&E SIL to demonstrate operation in a relevant environment at the system level; designed and fabricated onto a chassis in the SIL to address the realistic challenges of integrating HEV system components and operating them in a compact vehicle; lab tested and installed surrogate engine in the chassis; evaluated performance of chassis on inertial dynamometers with realistic duty cycles and terrain input; advanced M&S ability to include real time power and energy vehicle hardware-in-the-loop and man-in-the-loop experiments and analyses; began design of an advanced traction drive system; performed trade-off and performance assessments of spiral upgrade concepts for Future Force and Current Force vehicles; used early power and energy mission profile data to develop duty cycle experiments; and developed advanced thermal management strategy for FCS-like chassis. In FY07, purchase/build, integrate, and evaluate enhanced hybrid electric propulsion components (batteries, switches, controllers, compact engine/generator, thermal management, and power distribution systems) in SIL; begin validation of vehicle emulation model; add instrumentation to enable evaluation of Electromagnetic Interference (EMI) and evaluate EMI on the chassis; and continue to develop and incorporate FCS vehicle duty cycles for use in SIL. In FY08, will integrate advanced traction drive into the chassis; begin optimizing architecture for best thermal management; continue reducing EMI through filtering, shielding, and grounding; and continue to update power and energy mission profiles. In FY09, will complete optimization of architecture for thermal management; complete EMI reduction initiative; finalize power and energy mission profiles; and characterize and quantify performance of optimized architecture over profiles.	10854	8607	7892	7975
HEV Experimentation and Assessment: In FY06, conducted extensive literature search to identify all prior data available on performance of HEVs for military applications, analyzed data to obtain baseline expectations for TWV fuel economy specifications, and identified gaps in knowledge on technology maturity and performance parameters; analyzed User requirements to determine power levels; developed evaluation/test methodology for TWVs designed with HEV drive trains; obtained baseline performance data (including fuel consumption and measures of exportable power availability) on instrumented vehicles at test tracks using existing HEV demonstrators and current non-HEVs. In FY07, develop a set of representative duty cycles for light tactical vehicles for a variety of missions and determine an appropriate test operating procedure to enable direct comparison of HEV performance with that of non-HEVs particularly with respect to fuel economy, sustainability, and overall vehicle performance in tactical missions; provide input to and perform vehicle performance assessments in cooperation with the Future Tactical Truck System military utility assessment; use M&S to explore the variation in performance across various TWV missions/scenarios and various vehicle weights. In FY08, will continue analysis and testing of HEVs, with focus on M&S excursions to expand lessons learned from military utility assessment and conduct additional experiments and performance tests on medium vehicles designed with various HEV architectures. The Demos will also help refine HEV designs and/or applications to TWVs. In FY09, will continue analysis and testing of HEVs and available enhancements with focus on M&S excursions to expand lessons learned; conduct additional experiments and tests on heavy vehicles designed with various HEV architectures.	6000	2485	4832	4779
Advanced Hybrid Electric Vehicle (HEV) Components: In FY06, fabricated, assembled, and demonstrated a 40 kW high temp all-SiC motor inverter, a 10 kW/l traction motor; fabricated and conducted evaluations of enhanced Li-ion batteries from multiple vendors; fabricated and evaluated other advanced battery technologies, including graphite-foam enhanced cells; and advanced HEV system performance and maturity through competitive efforts to fabricate higher energy density traction motor, battery, and power electronic components. In FY07, mature and demo inverter, battery, traction motor, and DC-DC converter component technologies; conduct product evaluations/tests; continue evaluations and laboratory tests of Li-ion and other types of high performance batteries; evaluate advanced	7978	8794	6232	6115

thermal management technologies for maintaining coolant temperatures of 110 degrees C° during system demonstrations using innovative cooling techniques (i.e. spray cooling and hybrid cooling loop); and demonstrate component performance in high power density DC-DC converters and in-vehicle applications. In FY08, will; demonstrate advanced HEV-based modular drive train systems consisting of power sources and energy storage devices under different architectures in the propulsion lab, with focus on developing effective thermal management system architectures and power management control strategies that can be applied to next generation tactical vehicles; and mature and demonstrate system architecture designs for improving reliability, safety, and power consumption strategies. In FY09, will; demonstrate a complete vehicle electrical system designed for tactical vehicle applications implementing an advanced power and energy management/control strategy for both continuous and transient conditions and for pulse power operations; demonstrate built-in prognostics capable of predicting impending failures; and demonstrate exportable power management at different voltages based on realistic demands.				
Pulse Power: In FY06, designed and fabricated improved pulse power components, including faster output switches with 33 percent greater capacity, High Energy Density (HED) capacitors with 12 percent greater energy density (1.8 J/cc) miniturizing the capacitors to fit within the vehicle, and pulse chargers with 30 percent greater power density; inserted advanced components into the first generation HED, dual mode Pulse Forming Network (PFN); integrated and successfully lab tested a second generation dual purpose PFN. In FY07, demonstrate reduced size for critical pulse power components while maintaining the critical electrical performance needed for the dual mode PFN, the Solid State Laser (SSL) PFN and EM Gun switch; evaluate performance of improved HED capacitors in Advanced EM Armor application/vehicle demonstration; integrate and demonstrate transitional switch with improved pulse width for EM Gun at scaled power levels, and complete the design/development of the laboratory version of the a PFN/Battery Box for SSL. In FY08, will complete development of vehicle-ready version of the 100kW power supply for the SSL to include development, integration and test of high power-density batteries with the PFN/Battery Box, will continue to improve EM Gun Switch program with SiC based devices, will increase HED capacitors life by 25 percent and increase energy density of HED capacitors to 2.0J/cc. In FY09, will develop/demonstrate SiC based high-temperature, high power switches/devices and Si- and SiC-based power converters in support of EM Gun, high power microwave, and laser applications; continue to mature and demonstrate HED capacitor with improved DC lifetime as backup to rotating machine technology and HED batteries for other longer pulse applications; integrate and evaluate advanced thermal management techniques to increase efficiency and effectiveness of compact power, pulse power devices, and power converters. This is a collaborative effort between TARDEC/ARL.	5844	4912	6613	7599
HIPER: In FY06, evaluated advanced turbo-machinery and the associated control system and electronics to determine their effect on improving engine power density and efficiency; and completed design studies and trade-off analyses for advanced internal combustion configuration and high speed combustion. In FY07, install turbo-machinery system, including controls, on a high power density 440 kW capable test engine and conduct engineering tests to obtain performance and durability data.	2013	2013		
Advanced Lightweight Track: In FY06, used knowledge, expertise, and technologies gained from band track effort to analyze failures of current track systems. Designed a new segmented band track based on this analysis, combining the lightweight characteristics of band tracks with the higher supportability and robustness of linked steel track. Modeled and analyzed mine blast phenomena to develop survivable lightweight track system; and investigated new approach to the development of advanced elastomers for track applications. In FY07, fabricate prototypes of new segmented band track and a lightweight hybrid steel track, incorporating new bushing elastomers; and evaluate reinforcement and joint structural performance for anti-personnel mine blast survivability, heat transfer, and sprocket/track interfaces and analyze effectiveness. In FY08, will integrate and evaluate performance of the new segmented band track and hybrid steel track on demonstrator vehicles under field conditions with focus on durability and mobility.	4100	4004	3849	
JP-8 Reformation for Alternative Power Sources: In FY07, assess selected reformation and desulphurization technology approaches and		2472	4458	3931

begin initial system integration efforts for future laboratory hardware performance demonstration. In FY08, will begin integration of JP8 reformer to transportable system and interface with fuel cell. Integration will include optimization of key pieces to make the system transportable. This integration will be the first of many steps to making a JP8 reformation/fuel cell combination that will meet the size and signature requirements of the Army. In FY09, will complete integration of JP8 reformer; begin test plan and system integration for endurance test; and begin 1000 hour endurance test on JP8 reformer connected to fuel cell to produce power for a selected tactical vehicle application. At the conclusion of the 1000 hour endurance test, the fuel cell will be sent to TARDEC for an addition 300 hour test that may include extreme cold and/or hot conditions. After meeting TARDEC's environmental tests, planning for the next phase can begin.				
Fuel Efficiency ground vehicle Demonstrator (FED): In FY08, use modeling and simulation that exploits advanced materials and construction techniques to design a tactical wheeled vehicle significantly lighter and more fuel efficient than the HMMWV with comparable or improved mobility and survivability; identify potentially high pay-off lightweight/fuel efficient designs and components (such as electric/hybrid electric propulsion systems, high energy density, high efficiency engines, advanced power units, fuel cells, advanced batteries, lightweight armors, electric motors, lightweight/durable suspensions, and energy efficient tires); select best design and begin physical fabrication/integration effort. In FY09, will complete demonstrator fabrication/integration and conduct comparative performance evaluations, using M1114 Up-armored HMMWV as baseline; analyze test results and make recommendations for future vehicles.			10000	10000
Small Business Innovative Research/Small Business Technology Transfer Programs.		912		
Total	36789	34199	43876	40399

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**497**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
497 COMBAT VEHICLE ELECTRO	8609	9564	13110	7500	7643	7763	7934	8108

A. Mission Description and Budget Item Justification: This project matures, integrates, and demonstrates vehicle electronics hardware (displays, sensors, communications systems, and vehicle command/control/driving mechanisms) and software that result in increased crew efficiencies, performance, and/or reduced crew size for Future Force vehicles and, where practical, for insertion into Current Force vehicles. The project advances open system architectures for ground combat vehicles that allow more efficient crew stations to be adapted for a variety of Future Force ground platforms. Technical challenges include: increased levels of automation for both manned and unmanned systems, advanced user interfaces that support improved/increased span of control for robotic operations, and collaborative vehicle operations, workload management, reliability of driving aids and commander's decision aids, and embedded simulation for battlefield visualization and fully integrated virtual test/evaluation. The Robotics Collaboration effort matures and demonstrates common scaleable user interface software that can reside on multi-screen mounted crewstations, single screen operator control units, or small Soldier portable devices. A major objective is to construct a common scaleable interface that has potential to reduce platform-unique training requirements by providing intuitive interfaces with a common look, feel, and function across a range of devices for the control of unmanned ground and air systems. The interface is designed to allow graceful degradation of the display system, reconfiguring controls and displays in the event of hardware failure and to provide associated functionality to the Soldier upon the discovery of available services. Robotics Collaboration also matures and refines mounted crew and dismounted Soldier task models, combines these in an Intelligent Systems Behavior Simulator (ISBS), and conducts focused experiments that will define key metrics and drive development of embedded intelligent agents that have potential to lessen Soldier workload and reduce and/or automate mounted and dismounted system control tasks. This work is performed in conjunction with Robotics Collaboration effort described in project 515. Force protection measures of the future require the mounted Soldier to operate for extended periods of time under armor with hatches closed. When operating in this mode, the Soldier's local situational awareness and ability to maneuver the vehicle currently are degraded. A portion of this project focuses on Intelligent Secure Mobility (ISM), work that seeks to improve mobility and survivability by collecting and analyzing data from vehicle sensors to provide mounted Soldiers and crew with enhanced local area awareness augmented-reality inside the vehicle. Unmanned assets organic to the platoon expand the local sensing sphere to increase standoff distances and response times. Real-time embedded models predict vehicle system behavior to support safe mobility and weapon operations. The effort supports definition and refinement of requirements based on employment of human factor methodologies and through human-in-the-loop static and ride-motion simulation. The Robotics Collaboration and ISM work is performed in close cooperation with the Army Soldier Battlelab. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, in conjunction with Army Research Laboratory - Human Resources Engineering Directorate (ARL-HRED), Aberdeen, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
CAT ATD: In FY06, conducted final operational warfighter experiments in a relevant military environment demonstrating commander's and driver's crew-aiding behaviors and automated planning features; evaluated electronic control architecture and embedded mission planning, rehearsal, and training capabilities.	2000			
Robotics Collaboration: In FY06, developed baseline ISBS began developing relevant intelligent agent software and identifying baseline tasks that may be adaptively automated; initiated designs for common scalable interfaces and evaluated them through simulation and field experiments. In FY07, refine and model additional crew control tasks, display information, and intelligent agents; integrate display	6609	9314	13110	7500

designs and intelligent agents into target hardware; conduct experiments in which Soldiers evaluate the mounted and dismounted scaleable interface; and measure the impact of controlling unmanned (and manned) systems on Soldier task work load during performance of militarily significant combat scenarios. In FY08, will refine task timelines and models in the ISBS environment based on FY07 Soldier evaluations and experimental data; conduct final design and integration of scaleable interface software and intelligent agents into mounted and dismounted system hardware and perform final capstone Soldier operational field experiments in militarily significant combat scenarios in urban environments, capturing all relevant performance data. In FY09, will perform ISM human-in-the-loop simulation experiments to identify best design approaches for augmented reality interface and automation capabilities required for vehicle navigation and local awareness; begin development of augmented reality and automation technology; begin development of predictive models for safe mobility and weapon operations.				
Small Business Innovative Research/Small Business Technology Transfer Programs.		250		
Total	8609	9564	13110	7500

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**515**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
515 ROBOTIC GROUND SYSTEMS	12221	17391	9484	10248	10390	11020	11178	11341

A. Mission Description and Budget Item Justification: This project matures and demonstrates unmanned ground vehicle technologies for the Future Force and explores feasibility for enhancements to the Current Force. The main focus is on integrating and demonstrating in relevant environments sensor technologies, perception hardware and software, and robotic control technologies that enable Unmanned Ground Vehicle (UGV) systems to maneuver on- and off-road at militarily significant speeds with minimal human intervention, thereby enabling the Soldier to perform other mission tasks. Technical challenges addressed include: obstacle avoidance, perception limitations, intelligent situational behaviors, command and control, frequency of human intervention, operations in adverse weather, and robots protecting themselves and their surroundings from intruders. Mature technologies are incorporated in UGV technology demonstrators so that performance can be evaluated for tactical maneuver and sustainment applications. The Near Autonomous Unmanned Systems effort matures a set of automated tactical behaviors and self-security systems that allow unmanned vehicles to perform intelligent tactical maneuvers in a semi-autonomous mode and enable self-protection through the identification and deterrence of human threats. These technologies are integrated with sensor hardware, appropriate mission modules, and integrated onto a demonstration platform. Potential missions/functions include perimeter security, medical supply, and evacuation, scout/reconnaissance, and remote weapons delivery. The Robotics Collaboration effort develops, matures, and demonstrates models that optimize the way Soldier-robot teams perform operations. Models are validated through both man-in-the-loop simulation and field experiments in which Soldier-robot teams perform military relevant scenarios. It develops 3D models and algorithms using colorized ranging with LADAR and visual sensors for safe operations of unmanned systems around humans. In addition, this effort focuses on developing and demonstrating UGV behaviors, including force protection and tactical/reactive/self-security, which provides the ability to consistently operate safely in a semi-autonomous mode in urban environments in the presence of Soldiers, pedestrians, and other vehicles. It also matures technologies that contribute to improved/enhanced navigation. Work done in this project is complementary to the Robotics Collaboration effort described in project 497. The approach builds upon, complements, and does not duplicate previous and ongoing investments conducted under the Joint Robotics Program Office and the Defense Advanced Research Projects Agency, in program element (PE) 0602601A (project H91, Tank and Automotive Technology) and PE 0602618A (Ballistic Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by Tank Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, in collaboration with the Army Research Laboratory (ARL), Adelphi, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Robotic Follower: In FY06, integrated improved obstacle detection algorithms for detection of small positive and negative obstacles; implemented software to establish road-following, traffic-avoidance baseline for improved lane maintenance as well as traffic/pedestrian detection and avoidance; implemented improved leader-follower algorithms to enable increased mobility using waypoints augmented with terrain-intelligent navigation; demonstrated significant reduction in operator/controller workload; conducted experiments focused on providing dismounted Soldiers support when conducting operations in urban areas; performed final engineering evaluations and operational warfighter experiments that demonstrated program performance exit criteria.	3000			
Near Autonomous Unmanned Systems: In FY06, installed and evaluated performance of a perception suite designed in PE 0602618A (project H03) on a mobile testbed and initiated testing on a tracked skid steer platform; matured algorithms for unmanned tactical behaviors and self-security hardware and software required to meet user needs; began to integrate tactical behavior algorithms and self	7321	12993	5037	4492

security subsystems into testbed platform in preparation for FY07 field evaluations. In FY07, integrate intrusion detection sensors and day/night sensor packages onto testbed and conduct performance evaluations in reconnaissance, surveillance, and target acquisition mission scenarios; integrate and assess tactical behavior algorithms designed to enable maneuver- and formation-based missions; integrate human detection and tracking components associated with self-security suite into testbed and evaluate performance through engineering testing; conduct warfighter field evaluations and experiments to assess maturity and assist in development of tactics, techniques, and procedures; and continue to mature tactical behavior algorithms and self protection technologies using data collected from field experiments. In FY08, will; develop and begin integration of tactical behavior algorithms required for scout missions; and mature entire suite of tactical behaviors and begin integration of human intent analysis algorithms to vehicle self-security system. In FY09, will; complete integration of tactical behavior algorithms and self-security suite; and conduct final capstone Soldier-in-the-loop field experiments in a militarily relevant environment and in a militarily significant scenario.				
Robotics Collaboration: In FY06, conducted simulations and experiments to evaluate performance of a Soldier-portable control device for teleoperation of unmanned systems; and began developing 3D models and algorithms based on LADAR and visual sensor data for safe operations of UGV_s around humans. In FY07, conduct experiments to test and evaluate Soldier-robot teaming models in the performance of militarily significant combat scenarios employing unmanned systems; and conduct engineering evaluations to collect data and refine initial safe operation models. In FY08, will integrate Soldier-robot teaming and safe-operations algorithms into target hardware and perform final capstone Soldier-field experimentation in urban environments to obtain performance data. In FY09, will provide input to support development of requirements for safe operations of UGVs in urban environments in conjunction with users, and initiate development of baseline behaviors that will enable UGVs to navigate around people and other vehicles.	1900	3909	4447	5756
Small Business Innovative Research/Small Business Technology Transfer Programs.		489		
Total	12221	17391	9484	10248

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**53G**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
53G FUTURE COMBAT SYSTEMS (FCS)	34445	20563	14215	12069				

A. Mission Description and Budget Item Justification: Although the Future Combat Systems (FCS) program transitioned into the System Development and Demonstration phase in May 2003, maturing, demonstrating, and transitioning enabling technologies to FCS remains a priority for Army S&T. This project funds FCS related combat vehicle and automotive related technologies including armor, active protection, power and energy, and unmanned systems, as well as the Army's share of the Army/DARPA collaboration on Enabling Technologies for FCS. A portion of the funds in this project are executed in collaboration with DARPA for selected collaborative projects focused on enabling and enhancing FCS capabilities and are executed by DARPA in accordance with project-specific Memoranda of Agreement. When mature, technologies developed under this project will be available for transition into the FCS acquisition program to enable objective capabilities. Major DARPA related efforts include the following: Unmanned Ground Combat Vehicle (UGCV)/PerceptOR Integration (UPI), which matures and demonstrates an Armed Robotic Vehicle (ARV) with advanced sensors to enable agile, tactical performance, and reduce ARV development risk; Affordable Adaptive Conformal Electronically Scanned Array Radar (AACER), which demonstrates a high resolution Ground Moving Target Indicator/Synthetic Aperture Radar (GMTI/SAR) to provide FCS all weather, tactical surveillance, and tracking of ground targets and dismounts; Multi-cell and Dismount (M&D) Command and Control (C2), which demonstrates software and handheld C2 situational awareness and decision aid displays and conducts field experiments to demonstrate benefits of real time battlefield awareness; Organic Air Vehicle (OAV), which demonstrates ducted fan technology for Class II unmanned air vehicle (UAV) including a demonstration of Class II mission equipment package; Jigsaw, which demonstrates three dimensional Laser Radar (LADAR) for day or night detection and identification of hard-to-find targets through foliage or camouflage; Foliage Penetration (FOPEN) Reconnaissance, Surveillance, Tracking, and Engagement Radar (FORESTER), which demonstrates an airborne FOPEN ultra high frequency GMTI radar to detect and track small and medium size moving targets; WolfPack, which demonstrates a small sensor package capable of long duration and having multi-delivery options, for unattended, networked ground sensor/jammer capabilities that will enable signal detection of low power, low probably intercept/low probably detection threat signals, and provide for interruption via blanket or precision electronic attack; and Air Assault Expeditionary Force experiment (AAEF), which demonstrates tactical vertical maneuver of mounted forces enabled by emerging C4ISR and other promising technologies with live forces in a field environment. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is managed by DARPA, Arlington, VA. Expanded description of these efforts may be found in the DARPA R2 Exhibits.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, AACER - completed fabrication of demonstrator modules and perform subsystem tests, system integration, and rooftop tests; AAEF - executed a full scale experimental demonstration; FORESTER - designed, assessed, and evaluated form-fit-and-function demonstrator hardware system for rotorcraft installation and demonstrate end-to-end system performance tests that include aircraft effects under static and dynamic conditions; Jigsaw - completed fabrication of demonstrator equipment and demonstrate active 3-D imaging for hard-to-identify targets; OAV - conducted critical design review and began demonstrator fabrication; UPI - selected ARV weapon payload and conducted initial demonstration testing of two platforms; WolfPack - demonstrated threat sensor/jammer capabilities as part of the FCS C4ISR structure.	34445			
In FY07, AACER - fabricate optimized integrated airborne system antenna array and perform ground performance demonstrations; AAEF - perform operational assessment of warfighting utility of FCS enabling technologies and concepts, in an operational environment, via		19984		

experimentation with surrogates and mature demonstrator hardware/software. MNM - validated MNM concept with perform 10-node demonstration tests on improved MIMO hardware/software demonstrator; UPI - conduct full-up demonstration of enhanced capability sensors on two UGCV platforms; initiate a redesign and build of the Crusher vehicles to address ARV requirements.				
In FY08, will conduct Armed Robotic Vehicle (ARV) subsystems including software and mission payloads and conduct subsystem design performance tests followed by integrated testing; will integrate and test armor and active protection components and will mature and integrate combat vehicle power and energy components.			14215	
In FY09, will complete integration of FCS ARV software and mission payloads and will conduct developmental and operational testing ARV vehicles. Will conduct integrated testing and demonstration of armor and active protection components on FCS combat vehicles.				12069
Small Business Innovative Research/Small Business Technology Transfer Programs.		579		
Total	34445	20563	14215	12069

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603006A - Command, Control, Communications Advanced Technolo**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	11964	11997	12255	9235	8841	8370	8554	8743
257	DIGITAL BATTLEFLD COMM	959	1434						
588	HIGH ALTITUDE AIRSHIP ACTD	175							
592	SPACE APPLICATION TECH	10830	10563	9179	4843	3641	4570	6193	6330
DF7	DF7			3076	4392	5200	3800	2361	2413

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates advanced technologies for space applications that benefit the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. It provides Space Force Enhancement applications for intelligence, reconnaissance, surveillance, target acquisition, position/navigation, missile warning, ground-to-space surveillance, and command and control capabilities. Advanced Space Force Enhancement technologies include electro-optical, infrared, multi/hyperspectral, synthetic aperture radar, and advanced data collection, processing, and dissemination in real and near real time. Project 588 funds the High Altitude Airship (HAA) Advanced Concept Technology Demonstration (ACTD), which matures technologies to enable a "near space" application. HAA technologies include airship structure, propulsion, flight control, and power generation required to carry heavy multi-mission payloads in an airship that has long dwell time at altitudes up to 65,000 feet. Project 592 funds the Space Applications Technology effort, which develops algorithms that optimally process space sensor data in real and near real time for integration into battlefield operating systems and demonstrates, evaluates, and defines Army technical requirements for space platform/sensor/datalink systems development. This project also provides space advanced technology risk reduction capability for ground-to-space surveillance and system development. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the US Army Space and Missile Defense Technical Center in Huntsville, AL. This program is designated as a DoD Space Program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603006A - Command, Control, Communications Advanced Technolo**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	12880	10851	10550	6052
Current BES/President's Budget (FY 2008/2009)	11964	11997	12255	9235
Total Adjustments	-916	1146	1705	3183
Congressional Program Reductions		-215		
Congressional Rescissions				
Congressional Increases		1450		
Reprogrammings	-916	-89		
SBIR/STTR Transfer				
Adjustments to Budget Years			1705	3183

FY08 and FY09 funds increased to fund a new classified project.

One FY07 congressional add totaling $1391 was added to this PE.

($1391) Exportable combat training centers (E-CTC)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603006A - Command, Control, Communications Advanced Technolo**	**592**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
592 SPACE APPLICATION TECH	10830	10563	9179	4843	3641	4570	6193	6330

A. Mission Description and Budget Item Justification: This project matures and demonstrates advanced space technology applications in support of the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. It provides Space Force Enhancement applications for intelligence, reconnaissance, surveillance, target acquisition, position/navigation, missile warning, and Space Situational Awareness by ground-to-space surveillance, and command and control capabilities. Advanced Space Force Enhancement technologies include electro-optical, infrared, multi/hyperspectral, synthetic aperture radar, and advanced data collection, processing and dissemination in real and near real time. The project develops algorithms that optimally process space and near-space sensor data in real and near real time for integration into battlefield operating systems; and demonstrates, evaluates, and defines Army technical requirements for space and near-space platform/sensor/datalink systems development. This project provides space advanced technology risk reduction capability for ground-to-space surveillance and systems development. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the US Army Space and Missile Defense Technical Center in Huntsville, AL. This program is designated as a DoD Space Program.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Distributed Imaging Radar Technology: In FY06, verified algorithms for distributed array implementation of Moving Target Indication (MTI) and integrated radar component for distributed aperture demonstrations with precise time synchronization. In FY07, field demonstrate and evaluate the distributed aperture radar brassboard with wide area MTI and imaging of moving targets; modify software and refine algorithms based on analysis of demonstration results. In FY08, will demonstrate modified software and refined distributed imaging radar algorithms on tactical air and/or high altitude platforms.	6138	5620	3182	
All Weather Radio Frequency (RF) Launch Detection: In FY06, developed detection, location, and classification algorithms and demonstrated algorithm feasibility for rocket propelled grenades and mortars. In FY07, develop an RF test receiver to implement the baseline algorithm; mature algorithms and expand threat set to include tanks and artillery; and assess system receiver hardware requirements to extend field of view for increased detection range. In FY08, will mature and evaluate algorithms for an expanded threat set, to include rockets and missiles and assess space and battlefield RF receiver requirements for tactical applications.	1161	2315	2308	
Ground Based Space Surveillance: In FY06, continued to reduce algorithm processing timelines and initiate new threat signature development; initiated netted sensor hardware and software development. In FY07, complete expanded threat set signature and processing efforts, integrate netted sensor hardware/software, and demonstrate adjunct mobile data processor with ground sensor. In FY08, will complete algorithm and netted sensor hardware/software development; will demonstrate full adjunct mobile data processor with ground sensor in netted ground architecture; and transition ground based space surveillance technology to prototype systems development.	1031	2351	2533	
Joint Warfighting Space/Tactical Satellite: In FY06, cooperatively developed Hyperspectral Imaging payload with Air Force Research Laboratory to demonstrate Joint Warfighting Space Tactical Intelligence, Surveillance, and Reconnaissance needs with in-theater satellite	2500			

tasking and satellite mission downlink capabilities.				
Vertical Integration of Space Technology and Applications: In FY08, will identify key technologies to define multi-agent framework for intelligent agent, knowledge centric management techniques, and adaptive applications to vertically and horizontally integrate space products and services within LandWarNet environment; will demonstrate key technologies and non-integrated laboratory tests to support proof of concept. In FY09, will develop and mature application program interfaces and baseline software components to verify compatibility of intelligent agent and knowledge management technologies.			1156	4843
Small Business Innovative Research/Small Business Technology Transfer Programs		277		
Total	10830	10563	9179	4843

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603007A - Manpower, Personnel and Training Advanced Technolo**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	9796	9200	6783	6871	6895	6979	7121	7267
792	Personnel Performance & Training	6347	6579	6783	6871	6895	6979	7121	7267
79A	Personnel & Training Adv Tech Initiatives (CA)	3449	2621						

A. Mission Description and Budget Item Justification: This program element (PE) funds the Army's behavioral and social science advanced technology development program that provides non-materiel solutions to transform the human warfighter in concert with the technological transformations in systems, weapons, equipment, and the changes in mission requirements to meet the goals of the Future Force. The program develops, matures, and demonstrates (1) technologies to assess how Soldiers and units are impacted by mission, policy, or program changes; (2) training techniques that will enable Soldiers to take full advantage of advances in technology and systems as they evolve and that will help the Army attain its goals of embedded training in future combat systems; and (3) strategies and tools to enhance leader development so younger leaders have tactical and strategic capabilities and can easily adapt to changing mission demands. In addition, this program also exploits opportunities to enhance Current Force capabilities. This program leverages and coordinates with work in outside organizations such as the Institute for Creative Technologies (ICT), Simulation and Training Technology Center (STTC), and US Air Force Research Laboratory (USAFRL). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This PE is managed by the US Army Research Institute for the Behavioral and Social Sciences (ARI).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603007A - Manpower, Personnel and Training Advanced Technolo**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	10235	6794	6336	6383
Current BES/President's Budget (FY 2008/2009)	9796	9200	6783	6871
Total Adjustments	-439	2406	447	488
Congressional Program Reductions		-177		
Congressional Rescissions				
Congressional Increases		2650		
Reprogrammings	-439	-67		
SBIR/STTR Transfer				
Adjustments to Budget Years			447	488

Two FY07 congressional adds totaling $2540 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1246) Battle Command Team Training (BCTT) Program
($1294) Modeling & Simulation for Homeland Defense

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603007A - Manpower, Personnel and Training Advanced Technolo**	**792**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
792 Personnel Performance & Training	6347	6579	6783	6871	6895	6979	7121	7267

A. Mission Description and Budget Item Justification: The objective of this project is to refine, mature, and demonstrate advanced behavioral and social science technologies that enhance performance to ensure that the human warfighter keeps pace with the transformations in systems, weapons, equipment, and mission requirements to meet the goals of the Future Modular Force. The project, where feasible, exploits opportunities to enhance Current Force capabilities. Advanced technology development efforts include: maturing and demonstrating training methods and techniques that prepare battle commanders to effectively operate in digitized, networked environments, and that enable the use of embedded training technologies envisioned for future command and control (C2) systems, such as the Future Combat System (FCS); devising strategies to use distributed and game-based technologies for effective multi-site training, assessment, and feedback; developing improved tools for selecting and classifying personnel for flight training; and developing tools that capitalize on the various synthetic environments that facilitate the advancement of leader knowledge, skills, and abilities (KSAs), and that can provide virtual mission experiences to leaders earlier in their career development cycle to foster cognitive flexibility, adaptability, and mission readiness. In addition, this project matures techniques to determine the effects of policy changes (such as implementation of the Army Force Generation Model [ARFORGEN]) and operational changes (such as increased number and length of deployments) on unit cohesion and Soldier readiness. This program leverages and coordinates research efforts with the Institute for Creative Technologies (ICT), Simulation and Training Technology Center (STTC), and Communication-Electronics Research Development and Engineering Center (CERDEC). Work in this program element (PE) is related to and fully coordinated with efforts funded in PE 0601102 project 74F and PE 0602785 project 790. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This PE is managed by the US Army Research Institute for the Behavioral and Social Sciences (ARI).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Personnel Technology: FY06, assessed small-unit cohesion and identified the most critical factors influencing cohesion in a stabilized (personnel) unit environment; refined a new test battery by leveraging existing military selection tests and developing new tests that improve the Army's capability to select individuals with the highest potential to be successful aviators. FY07, conduct trend analysis of longitudinal research findings of the effects on unit cohesion of stabilizing unit personnel, provide lessons learned to Army G-1 and CG, Human Resources Command, from the first stabilized brigade from stand-up through post-deployment to inform early stages of implementing ARFORGEN; and validate new Selection Test Battery to determine the extent to which it predicts aviator performance in Initial Rotary Wing Training. FY08, will refine aviation Selection Test Battery and investigate its validity as a tool to assign aviators to specific aircraft. FY09, will refine and mature test batteries that improve the classification and assignment of aviators into specific aircraft for enhanced operational readiness.	2158	1796	1914	1927
Training Technology: FY06, demonstrated preliminary training products needed to support spin out of Future Force technological capabilities to the Current Force; evaluated alternative learning models and assessment methods to determine the effectiveness of single-user immersive training technologies; and refined prototype game-based system for training night vision skills and a preliminary system for creating simple game-based training for use in improving basic Soldier skills and knowledge. FY07, refine products and techniques that provide train-up tools for experiments on the spin out of Future Force technological capabilities to the Current Force; and refine learning models for single-user immersive training technologies and the potential assessment methods to determine effectiveness of these	2602	2644	2734	2822

technologies. FY08, will refine and demonstrate methods for more rapid development of training support packages that will meet future technology and system spin out requirements; will validate assessment methods of single-user immersive training technologies; and will develop preliminary guidelines for designing effective single user, interactive, distributed training using game-engine-based immersion. FY09, will mature prototype training and training support packages that enable improved commander and staff performance in network-enabled environments; and will validate and refine assessment measures and metrics used in single-user immersive training technologies for their potential in determining multi-user training effectiveness.				
Leader Development Technology: FY06, refined web-based training modules for eight high-impact critical thinking skills for Army leaders, such as using mental imagery to evaluate plans and challenging one's own biases or stereotypes; and transitioned filmed case study vignettes for teaching leadership skills to several Active Army and Army Reserve schools and units, accompanied with train-the-trainer materials so they could effectively use the vignettes for pre-deployment training of junior leaders. FY07, implement critical thinking training modules and leader development case-study vignette approaches in select brigade combat teams and assess the impact on development of basic leadership skills (critical thinking, interpersonal, self-assessment) using protocols developed in applied research. FY08, develop lower cost techniques to train leaders to be adaptable, lead teams more effectively, and provide a wider range of strategies that improve the probability of mission success. In FY09, expand and refine low-cost tools for developing the techniques and strategies that leaders at all levels will need as the basic elements necessary for command in future scenarios.	1587	2028	2135	2122
Small Business Innovative Research/Small Business Technology Transfer Programs		111		
Total	6347	6579	6783	6871

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603008A - Electronic Warfare Advanced Technology**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	52236	53129	49199	51213	52230	55304	56521	57764
TR1	TAC C4 TECHNOLOGY INT	18028	22073	35983	37713	39206	41175	42081	43007
TR2	DIGITAL BATTLEFLD COMM	25487	21463	13216	13500	13024	14129	14440	14757
TR8	C3 DEMONSTRATIONS (CA)	8721	9593						

A. Mission Description and Budget Item Justification: The goal of this program element(PE) is to provide enabling technologies for a secure, mobile, wireless network that will operate reliably in diverse and complex terrain, in all environments for the Army's Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Technologies will be matured and demonstrated to address this challenge with distributed, mobile, secure, self-organizing communications networks. A key objective is to demonstrate seamlessly integrated communications technologies across all network tiers, ranging from unattended networks and sensors through maneuver elements and airborne/space assets. To accomplish the goal this PE will investigate and leverage external communication technologies and combine technology options in a series of Command, Control, Communications, and Computers Intelligence, Surveillance, and Reconnaissance (C4ISR) On-The-Move (OTM) experiments to measure the battlefield effectiveness for the Future Force. This PE also provides: protection technologies for tactical wireless networks against modern network attacks; smart communication technologies to network and control unmanned systems anywhere on the battlefield enabling timely sensor-decider-engagement linkage to defeat critical targets; advanced antenna technologies for greater communications mobility, range, and throughput; and automated network management aids. Several tasks are conducted in conjunction with the Defense Advanced Research Projects Agency (DARPA) and the other Services. Project TR8 funds congressional special interest efforts.

Since the current program element 0603008A project TR2 efforts are complementary to those funded from 0603008A project TR1, all efforts funded and executed from project TR2 are being transferred to project TR1 in FY08 and beyond, to reduce administrative burden. In FY08 and beyond, TR2 will contain only those efforts transferred from 0603238 (Global Surveillance/Air/Precision Strike) project 177 (JT ALS PS DEMO) to support the advanced technology demonstration for PEO IEW&S and will be executed by the Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ. In FY08, the Joint Programs Sustainment and Development (JPSD) Project Office, an element of the Program Executive Office, Intelligence, Electronic Warfare, and Sensors (PEO IEW&S) will be disbanded.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0602782A (Command, Control, Communications Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology). Work is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603008A - Electronic Warfare Advanced Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	60515	44022	37663	37780
Current BES/President's Budget (FY 2008/2009)	52236	53129	49199	51213
Total Adjustments	-8279	9107	11536	13433
Congressional Program Reductions		-203		
Congressional Rescissions				
Congressional Increases		9700		
Reprogrammings	-8279	-390		
SBIR/STTR Transfer				
Adjustments to Budget Years			11536	13433

In FY08 and beyond funding was transferred to PE/project 0603008/TR2 from PE/project 0603238/177 to support advanced technology demonstration (Theater Effects Based Operations).

Five FY07 congressional adds totaling $9297 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($3115) Portable & Mobile Emergency Broadband Systems
($1390) JT Unified Maritime Protection System (JUMPS)
($958) Advanced Wireless Technologies
($2588) Applied Comms & Information Networking (ACIN) Prog
($1246) JEM Radio Communications Range Extension

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603008A - Electronic Warfare Advanced Technology**	**TR1**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
TR1	TAC C4 TECHNOLOGY INT	18028	22073	35983	37713	39206	41175	42081	43007

A. Mission Description and Budget Item Justification: This project matures and demonstrates key communications, mobile networking, and information assurance technologies for the dismounted Soldier, embedded network communications, and the Future Force. These technologies will enable commanders and individual Soldiers to survive and fight by providing secure, reliable, mobile communications network solutions that function in complex and diverse terrain. The Joint Tactical Radio System (JTRS) Squad-Level Integrated Communications (SLICE) effort matures and demonstrates communications technology to provide a JTRS Software Communications Architecture (SCA) Soldier Radio Waveform (SRW). This effort addresses communications connectivity and network interoperability between dismounted Soldiers and the Future Combat System (FCS) brigade combat team (BCT) manned and unmanned systems within the size, weight, power consumption, and safety constraints of embedded JTRS Handheld, Manpack, and Small Form Fit (HMS) platform environments. Antenna Technologies will mature a family of mission tailored antennas to provide higher gains to sustain Wideband Network Waveform (WNW) link connectivities, reduce visual signature on ground platforms, increase resistance to damage from ballistic debris strikes, reduce the number of platform antennas while increasing their ability to support multiple waveforms, and integrate conformal, lightweight antennas within the Soldiers' protective combat wear for suppressed equipment visual signatures, improved mobility, survivability, and fightability. The Tactical Wireless Network Assurance (TWNA) effort provides network protection for mobile wireless ad hoc networks and provides safeguards against modern network attacks. It provides network assurance through enhanced net access controls. It also focuses on wireless intrusion detection to detect unauthorized access attempts. The effort matures and demonstrates mobile data security solutions and protection of secure database elements. The Proactive Integrated Link Selection for Network Robustness effort matures and integrates technologies to provide automatic network communications link selections that address the challenge of limited network connectivity due to an inability to optimally use all available communication types. The Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) effort will mature software tools that enable the Warfighter to dynamically plan, predict, and visualize network communications performance due to maneuver and environmental effects faster than real time (virtual). COMPOSER is the Army component to the Coalition Joint Spectrum Management and Planning Tool (CJSMPT) Joint Capability Technology Demonstration (JCTD).

Since the current program element 0603008 project TR2 efforts are complementary to those funded from 0603008 project TR1, all efforts funded and executed from project TR2 are being transferred to project TR1 in FY08 and beyond, to reduce administrative burden.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
JTRS Squad-Level Communications: In FY06, delivered initial release of the SRW 1.0 to JTRS JPEO for porting to JTRS Ground Mobile Radio (GMR) and HMS target operating environments to support FCS BCT Spin Out #1 system integration; completed SRW Increment 2.1 development with enhanced voice and data communications services for dismounted Soldier and unmanned ground sensors/intelligent munition systems network applications up to 25 networking nodes in high fidelity laboratory and operationally relevant	9913	9700		

field test environments; validated interoperability between manned and unmanned systems; and conducted operational experimentation in the C4ISR OTM experiment and Air Assault Expeditionary Force with Future Force Warrior (FFW) ATD, and actual troops operating up to 85 networking nodes. In FY07, complete SRW voice and data communications services for dismounted Soldier applications; extend application for unmanned aerial vehicle; and unmanned ground vehicle to support teleoperations/navigation, ISR data transport, and communications range extension services; complete validation of SRW network performance in technical test in laboratory and field environments; conduct follow-on operational experiments with FFW ATD and FCS BCT Spin Out #1; and deliver final release of SLICE SRW 2.1 software application to JTRS JPEO for porting to JTRS GMR and HMS for JTRS SCA and NSA security certifications.				
Antenna Technologies: In FY06, completed, tested, and validated breadboard WNW high gain antenna; evaluated triband antennas with improved gains and reduced form factors, developed a diplexer to couple a fourth waveform into the triband antenna; completed live fire evaluation of ballistic radome, and improved gain of survivable low profile antenna. In FY07, improve gain performance of triband antenna with diplexer; demonstrate prototype triband antennas; improve gain performance of survivable low profile antennas with the ballistic radome; demonstrate dual band antenna system in an OTM environment; develop high efficiency Ku power amplifier module; mature Ka power amplifier module; and complete development of X-band OTM antenna system. In FY08, will initiate development of affordable terrestrial directional antenna; will complete development of 2 port low profile prototypes; will complete ruggedization of triband and low profile antennas; integrate body wearable antennas with JTRS HMS; will develop and test low cost low profile directional antenna prototypes; will integrate and test dual band SATCOM antenna on a Warfighter Information Network-Tactical (WIN-T) vehicle; will complete development of power amplifiers and integrate into antenna assemblies; develop a low profile single beam SATCOM antenna; will demonstrate vehicle X-band OTM antenna system. In FY09, will mature and demonstrate a low profile single beam, single frequency SATCOM antenna to improve OTM satellite tracking performance and throughput; will begin to mature a single beam, two frequency low profile SATCOM antenna. Complimentary work was also accomplished under 63008 TR2 in FY06 and FY07. In FY08 and FY09, this work will be consolidated in this project.	4882	3077	7720	4088
Tactical Wireless Network Assurance (TWNA): In FY06, matured intrusion detection algorithms for FCS BCT to deter intruders and to recognize attempts to attack/exploit Mobile Ad-hoc Networks (MANETs); matured and tested Tactical Public Key (TPK) enabling capabilities in a simulated MANET environment. In FY07, mature intrusion detection system framework and integrate with FCS security management capability; mature certificate revocation capability within TPK framework to reduce impact of security overhead on MANETs; provide demonstration encapsulating matured wireless security capabilities; provide TPK enabling technologies to FCS/WIN-T.	2264	4907		
Wireless Information Assurance (IA): In FY09 will mature and demonstrate biometric software token technology in the TPK infrastructure framework for the tactical network environment; will provide updated TPK enabling technologies to WIN-T.				3350
Proactive Integrated Link Selection for Network Robustness: In FY06, performed initial implementation of network link selection algorithms that will be utilized during the planning and analysis of a network before deployment (planning mode link selection algorithms); performed modeling and simulation (M&S) and provided initial performance results. In FY07, mature design of planning mode components based on M&S results; mature system architecture to include design of deployed mode link selection technologies; begin M&S of deployed mode link selection algorithms. In FY08, will continue M&S and design of enhanced implementation of deployed mode link selection algorithms; will implement first level integration among link selection algorithms; will conduct performance characterization and scalability testing of mature link selection algorithms. In FY09, will complete implementation of deployed mode link selection algorithms; will conduct final architecture, design maturation, and integration of planning and deployed mode link selection algorithms; will conduct performance testing in a relevant field environment of all planning and deployed mode link selection technologies after integration of WIN-T hardware. Complimentary work was also accomplished under 63008 TR2 in FY06 and FY07. In	969	3059	7852	9069

FY08 and FY09, this work will be consolidated in this project.				
Communications Planner for Operational and Simulation Effects with Realism (COMPOSER): In FY07, integrate and test the communications effects simulator, network visualizer, and spectrum management software modules to support the baseline architecture for Coalition Joint Spectrum Management Planning Tool (CJSMPT) applications. In FY08, will further integrate and test enhanced COMPOSER technologies in support of the CJSMPT effort.		800	2744	
Dismounted Communications in Urban Terrain: In FY09, will mature communications capabilities for dismounted Soldier operating in highly complex terrain (e.g. urban environments) through the use of space-time adaptive processing, cross layer networking algorithms, and network security features such as employing random noise waveforms and other low probability of intercept, low probability of detection technologies to reduce communications systems vulnerability.				2500
Applied Communications and Information Networking (ACIN): In FY09, ACIN will mature and demonstrate commercial networking and communications technology in intelligent agents and mobile networking; will provide rapid adaptation of commercial communications equipment for military use through the development of new architectures combining commercial and military unique technologies; and will provide modeling and simulation for communications/network planning.				1957
C4ISR On-The-Move (OTM) Experiment: In FY08, will assess the capability, functionality, and performance of JTRS SRW version 2.2 and 3.0 on JTRS HMS and GMR representative hardware; will conduct the final experiment of the FCS Experiment Phase 2 Campaign to assess the capability, functionality and performance of FCS Battle Command, System of Systems Common Operating Environment (SoSCOE) and Spin Out 1 and 2 hardware and software; will assess the technology readiness level of Army science and technology efforts maturing in the FY08 timeframe in an operationally relevant field environment; will assess the performance of the baseline and alternative C4ISR on-the-move architectures and various network configurations to inform the current and future forces. In FY09, will assess the capability, functionality, and performance of the FY09 programmed increments of JTRS HMS for dismount Soldiers, unmanned ground sensors, non-line of site launch system and intelligent munitions systems; will assess WIN-T technology insertions to JNN such as an enhanced quality of service architecture, information assurance solutions to enable black core, and selected network operations management functions; will assess the technology readiness level of Army science and technology efforts maturing in the FY09 timeframe in an operationally relevant field environment; will develop or evaluate M&S capabilities and warfighting analyses techniques that enhance the ability to view systems and immerse humans in the virtual world to facilitate early assessment of new C4ISR technologies. In FY08 and FY09, this work will be consolidated in this project from TR2.			13007	11249
C4ISR Network Mining: Large-scale information technology has been evolving separate transaction and analytical systems, data mining provides the link between the two. Data mining consists of five major elements: extracting, transform, and load transaction data onto the data warehouse system, storing, and managing the data in a multidimensional database system; providing data access; analyzing the data by application software; and presenting the data in a useful format. In FY08, will mature network data mining software analysis to understand the relationships and patterns in stored transaction data based on open-ended user queries; will mature analytical software for use in battle command systems including statistical and machine learning. In FY09, will mature network data mining analytical software particularly neural networks for applicability to next generation battle command systems; will conduct demonstrations focused on four types of relationships. 1) Classes: stored data is used to locate data in predetermined groups. 2) Clusters: data items are grouped according to logical relationships or consumer preferences. 3) Associations: data can be mined to identify associations. 4) Sequential patterns: data is mined to anticipate behavior patterns and trends. Complimentary work was also accomplished under 63008 TR2 in FY06 and FY07. In FY08 and FY09, this work will be consolidated in this project.			4660	5500
Small Business Innovative Research/Small Business Technology Transfer Programs		530		

Total	18028	22073	35983	37713

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603008A - Electronic Warfare Advanced Technology**	**TR2**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
TR2	DIGITAL BATTLEFLD COMM	25487	21463	13216	13500	13024	14129	14440	14757

A. Mission Description and Budget Item Justification: In FY06 and FY07, This project matures and demonstrates an integrated Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) On-The-Move (OTM) (sensor to shooter) capability for the Future Force, and where feasible, exploits opportunities to enhance Current Force capabilities. It seeks to provide the ability to move large amounts of data over extended ranges with minimal infrastructure, tying in networks of unattended sensor fields. The efforts here concentrate on three major goals: provide a series of technology demonstrations of C4ISR capabilities to significantly reduce the risk associated with the networks of networks approach to the Future Combat System (FCS) brigade combat team (BCT) integrated on-the-move lethal force structure; provide critical links in the ability to communicate and move large amounts of information across the force structure in a seamless, integrated manner conducive to a highly mobile manned and unmanned force structure; and assess the Technology Readiness Level of emerging network technologies in an operationally relevant environment. C4ISR OTM provides an operationally relevant field experimentation venue complemented by constructive and virtual M&S for the assessment of emerging individual C4ISR technologies, system of systems, and architectures that will increase the survivability and lethality of Future Force platforms. Several key programs support these goals. The experiments will expand both the functionality and complexity of the integrated C4ISR system-of-systems, including the participation of Joint, Current, and dismounted elements experiments, align with Army Transformation critical objectives for C4ISR, and exploit opportunities to enhance Current Force (e.g. Stryker BCT) modernization. Adaptive Joint C4ISR Node (AJCN) Advanced Concept Technology Demonstration (ACTD) for mobile airborne communication nodes seeks to provide assured communications and also has the capability to perform signals intelligence, information warfare and electronic attack missions simultaneously. The Proactive Integrated Link Selection for Network Robustness effort will integrate automatic link selection technologies for Future Force networks. The Command, Control, and Communications (C3) OTM Network Mining matures and demonstrates network technologies that exploit and fuze existing data on the network to enable critical combat functions such as countermine, rapid Battle Damage Assessment (BDA), targeting/retargeting, and Combat Identification (CID). Radio Enabling Technologies and Nextgen Applications (RETNA) matures and demonstrates affordable radio components and enabling technologies to reduce Joint Tactical Radio System (JTRS) programmatic risk and improve performance reliability. Antenna technologies will develop a family of mission tailored antennas for ground vehicles and the Soldier. The ground vehicle antennas efforts will focus on high gain antennas to sustain Wideband Network Waveform (WNW) link connectivity; affordable OTM directional SATCOM antenna technologies will provide low cost, low profile ground-to-ground and ground-to-air links; and multi-band antennas that consolidate multiple waveforms using a single antenna to reduce the number of platform antennas. Soldier antenna efforts mature and integrate conformal, rugged, lightweight antennas within the soldiers protective combat wear for visual camouflage, improved mobility, and increased survivability.

In FY08 and beyond, Theater Effects Based Operations (TEBO) will provide United States Forces Korea (USFK) with enhanced capabilities to analyze, plan, execute, and assess operations, at strategic and operational levels, using an effects based approach. TEBO will integrate computer-aided decision support tools, concepts, and procedures to provide a more comprehensive understanding of a given adversary and the environment. TEBO will help to identify those actions that can be taken to influence behavior and facilitate the harmonization of all elements of national power to support national objectives. It will provide greater responsiveness and adaptability to better manage the rapidly changing situations of today's environment. TEBO will conduct a limited military utility assessment to determine the extent to which the TEBO concept has been adopted and incorporated into their staff organization processes. TEBO assessment tools will be incorporated into USFK Theater Architecture.

Since the current program element 0603008A project TR2 efforts are complementary to those funded from 0603008A project TR1, all efforts funded and executed from project TR2 are being transferred to project TR1 in FY08 and beyond, to reduce administrative burden. In FY08 and beyond, TR2 will contain only those efforts transferred from

0603238 (Global Surveillance/Air/Precision Strike) project 177 (JT ALS PS DEMO) to support the advanced technology demonstration for PEO IEW&S and will be executed by the Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ. In FY08, the Joint Programs Sustainment and Development (JPSD) Project Office, an element of the Program Executive Office, Intelligence, Electronic Warfare, and Sensors (PEO IEW&S) will be disbanded.

The cited work is consistent with Strategic Planning Guidance, the Army Science, and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research Development and Engineering Center (CERDEC), Fort Monmouth, NJ, and the Army Research Laboratory, Adelphi, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
C4ISR On-The-Move (OTM) Experiment: In FY06,conducted experiments to inform Program Managers the impact and effectiveness of C4ISR concepts; evaluated the technical performance of component C4ISR systems; reduced risk associated with system of systems integration; assessed the human factors of component systems; evaluated the end-to-end performance of complete operational mission threads; quantified the performance of varying system of systems configurations; conducted C4ISR system of systems operational assessments employing Soldiers in unscripted missions to determine C4ISR equipment effectiveness including dismounted and mounted JTRS Soldier Radio Waveform (SRW) nodes, WIN-T/Network Centric Waveform (NCW) Points of Presence, multiple unattended ground sensor fields, and multiple unmanned air and ground vehicles. In FY07, assess the capability, functionality, and performance of the programmed increments of: JTRS SRW 2.1 running on JTRS Handheld, Manpack, and Small Form Fit (HMS) hardware; WIN-T NCW waveform development; and JNN technology insertion; demonstrate commercial SATCOM, commercial wireless technologies, and protocols, Information Assurance and ISR sensor and sensor fusion in an operationally relevant field environment complimented with virtual and constructive modeling and simulation; conduct the initial experimentation under of the FCS Experiment Phase 2 Campaign to assess the capability, functionality, and performance of FCS Battle Command (1.0), SoSCOE (1.8) and Spin Out 1 and 2 hardware and software. In FY08 and beyond, funding for this effort was transferred to PE/project 0603008/TR1.	12423	11428		
Adaptive Joint C4ISR Node (AJCN) ACTD: In FY06, conducted Extended User Evaluation (EUE) efforts and provided sustainment support for leave behind equipment and supported transition initiatives. In FY07, complete EUE and sustainment for leave behind equipment.	1957	1060		
Proactive Integrated Link Selection for Network Robustness: In FY06, conducted controlled environment testing/demonstration of stand-alone link selection algorithms; transitioned the Agent Architecture module to WIN-T baseline. In FY07, mature planning mode link selection algorithms; begin implementation of deployed mode link selection algorithms; mature software operations to manage interactions and interfaces among link selection algorithms. Work on this effort is also being accomplished under PE/project: 0603008A/TR1. In FY08 and beyond, funding for this effort was transferred to PE/project 0603008/TR1.	1922	1968		
C4ISR Network Mining: Large-scale information technology has been evolving separate transaction and analytical systems, data mining provides the link between the two. Data mining consists of five major elements: extracting, transform, and load transaction data onto the data warehouse system; storing and managing the data in a multidimensional database system; providing data access; analyzing the data by application software; and presenting the data in a useful format. In FY06, conducted systems engineering efforts in Joint Architecture Analysis; analyzed performance of Command Post of the Future over tactical communications systems; tactical network data collection; and various other network and battle command application system engineering efforts; demonstrated, transitioned, and fielded data collection tools to the 101st infantry division during their MRX. In FY07, assess the three services network centric warfare program	1000	4213		

architectures and identify interoperability issues; provide the Training and Doctrine Command (TRADOC) the results of the analysis to influence requirements updates and support TRADOC campaign of experimentation effort; demonstrate, and transition updated data collection tools to the 25th Infantry Division. In FY08 and beyond, funding for this effort was transferred to PE/project 0603008/TR1.				
Radio Enabling Technologies and Nextgen Applications (RETNA): In FY06, identified, evaluated, and adapted emerging commercial technologies for military application to HMS and embedded Wideband Power Amplifiers (WBPAs); investigated thermal management techniques to efficiently transfer unwanted heat from targeted hot spots in Joint Tactical Radio Systems (JTRS) radios. In FY07, evaluate functional, integrateable (JTRS Software Communication Architecture (SCA) compliance) and operationally suitable products; validate performance of thermal management techniques via testing and analysis of HMS WBPAs' environmental performance.	507	1336		
Antenna Technologies: In FY06, evaluated conformal vest antenna prototypes and down-selected to best designs for integration into Future Force Warrior (FFW) Soldier ensemble; matured body wearable antennas to meet JTRS HMS requirements; conducted M&S of body wearable antenna designs and specific absorption rates for safety assessment. In FY07, complete antenna development and conduct test/demonstration of body wearable antenna prototypes for HMS. Work on this effort is also being accomplished under PE/project: 0603008A/TR1. In FY08 and beyond, funding for this effort was transferred to PE/project 0603008/TR1.	1450	965		
Theater Based Effects Operations (TEBO) ACTD: The TEBO ACTD will demonstrate an Effects-based Operations (EBO) process and will provide United Stated Forces Korea with enhanced capabilities to analyze, plan, execute, and assess effects-based operations at the strategic-theater and operational levels by integrating a framework of processes, tools, and tactics, techniques and procedures. In FY07, TEBO is funded and executed under PE/project 0603238/177. In FY08, mature TEBO software to Spiral V configuration; will mature and harden capabilities demonstrated in spirals I-IV to provide full spectrum support for effects-based operations including semi-automated knowledge acquisition and operational modeling and simulations; will mature human interfaces and scalability of the TEBO toolset demonstrate TEBO capabilities in Joint Forces Command (JFCOM) exercises in coordination with United Stated Forces Korea. In FY09, will initiate the sixth and final developmental spiral; will conduct the final military utility assessment of the TEBO capabilities; will transition activities for the TEBO toolset to Defense Information Systems Agency and Net-Centric Enterprise Services. Work on TEBO prior to FY08 was executed under PE/project 0603238/177.			13216	13500
Applied Communications and Information Networking (ACIN): In FY06, this one year congressional add matured and demonstrated commercial networking and communications technologies in the C4ISR areas of satellite receivers to assist first responders during Hurricane Katrina; handheld PDA communication terminal, target detection capabilities, web based software for call for fire; and vessel tracking system for Port Security. No additional funds are required to complete this effort.	6228			
Small Business Innovative Research/Small Business Technology Transfer Programs		493		
Total	25487	21463	13216	13500

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	24855	20863	18723	19002	20375	20623	20385	20856
HB5	IMMERSIVE ENVIRONMENTS DEMONSTRATIONS (CA)	2396	1780						
S28	INSTITUTE FOR CREATIVE TECH (ICT)-Adv Tech Dev	4929	5251	4833	4911	5102	5185	5307	5431
S29	MODELING & SIMULATION - Adv Tech Dev	1444	1702	3774	3916	4007	4091	3481	3573
S31	MATREX	10478	11141	10116	10175	11266	11347	11597	11852
S33	TRAINING AND SIMULATION SYSTEMS INITIATIVES (CA)	5608	989						

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates advanced technology for the next generation training and simulation systems of the Future Force (FF), and where feasible, the Current Force. Work is focused in three projects. The Institute for Creative Technology project S28 incorporates advanced modeling and simulation (M&S) and training and leader development technology into immersive training demonstrations that have an emphasis on urban operations. The Modeling & Simulation project S29 will demonstrate a framework for future embedded training and simulation systems for the FF to include the Future Combat System (FCS) and dismounted warrior systems. The MATREX project S31 develops and demonstrates the overarching M&S architecture that facilitates force-on-force modeling, supports the play of systems models, and provides access to measures of effectiveness. The MATREX project will also enable interoperable component engineering-level simulations and models that conform to the architecture specification to support and augment testing and training of the FF. Projects HB5 and S33 fund congressional special interest items. Work in this PE is related to and fully coordinated with efforts in PE 0602308A, project C90 (Advanced Distributed Simulation); PE 0602308A, project D02 (Modeling and Simulation for Training and Design); and PE0601104A, project J08 (Institute for Creative Technology). This work does not duplicate any effort within the military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Research, Development, and Engineering Command (RDE Command), Simulation and Training Technology Center, Orlando, FL, and Fort Belvoir, VA.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	27927	18296	20319	20436
Current BES/President's Budget (FY 2008/2009)	24855	20863	18723	19002
Total Adjustments	-3072	2567	-1596	-1434
Congressional Program Reductions		-80		
Congressional Rescissions				
Congressional Increases		2800		
Reprogrammings	-3072	-153		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1596	-1434

FY06 funds decreased to support higher priority efforts.

Two FY07 congressional adds totaling $2683 (after adjustment for Congressional undistributed reductions) were added to this PE.

($1725) ICT-Joint Fires & Effects Training Systems
($958) Vigilant Auto ID & Access Control System

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**	**S28**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
S28	INSTITUTE FOR CREATIVE TECH (ICT)-Adv Tech Dev	4929	5251	4833	4911	5102	5185	5307	5431

A. Mission Description and Budget Item Justification: This project will mature and demonstrate affordable immersive technologies that include the application of photo-realistic synthetic environments, multi-sensory interfaces, virtual humans, and training applications on low-cost game platforms. Immersive technologies will enrich the Army's capabilities and readiness by expanding the types of experiences that can be trained or rehearsed, and by improving the effectiveness of the experience and the quality of the result. The synergy between these immersive technologies and the embedded training advanced technology maturation within project S29 (Modeling and Simulation) of this PE will provide units with a set of complementary embedded and deploy-on-demand systems that provide just-in-time, dynamic, realistic training, and mission rehearsal capabilities. This project will use advanced modeling, simulation, and leadership development techniques to leverage the emerging immersive technologies that are being created at the Institute of Creative Technologies (ICT) University Affiliated Research Center (UARC) at the University of Southern California to formulate training demonstrations that will have an emphasis on urban operations and asymmetric warfare. The ICT's collaboration with its entertainment partners and the Army Training and Doctrine Command (TRADOC) will create a true synthesis of creativity and technology that harnesses the capabilities of industry and the R&D community to advance the Army's ability to train and practice military skills across the full spectrum of conflict. This project was set up to enable transition of basic and applied research resulting from PE0601104A, project J08 (Institute for Creative Technology) and PE 0602308A, project D02 (Modeling and Simulation for Training and Design). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Research, Development, and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Immersive Techniques: In FY06, matured artificial intelligence and immersive technologies to enable mentoring capabilities. Demonstrated a training and mission rehearsal environment that includes real and synthetic objects. Matured interfaces to support interoperability of virtual human environments with military simulations. Developed leaning environment prototype integrating mentoring and rapid scenario generation techniques. In FY07, assess and refine the integration of pedagogical and situational aspects of rapid scenario development techniques into immersive environments. Assess and refine the integration of intelligent mentoring capabilities into a single user immersive simulation learning environment. Demonstrate methods to integrate political, religious, and cultural traits into immersive environments. Demonstrate the integration of specific immersive environments that each enables critical urban characteristics. In FY08, will assess and refine methods to integrate political, religious, and cultural traits into immersive environment terrain. Will demonstrate methods to integrate cultural traits into avatars operating in interactive environments. Will assess and refine the integration of specific immersive environments that each enables critical urban characteristics. Will create visualizations of the complex urban environment to support both immersive training and command and control concepts. In FY09 will integrate photorealistic representations of complex terrain and rendering of specific individual facial features onto interactive avatar models operating in an asymmetric environment to support more realistic training. Will demonstrate methods to extend the immersive environment to larger format applications that support multi-player and team training. Will demonstrate methods to support computer generated after action reviews, computer avatar-based mentoring, and computer directed scenario adaptation based on multi-player distributed training challenges.	4929	5103	4833	4911

Small Business Innovative Research/Small Business Technology Transfer Programs		148		
Total	4929	5251	4833	4911

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**	**S29**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
S29	MODELING & SIMULATION - Adv Tech Dev	1444	1702	3774	3916	4007	4091	3481	3573

A. Mission Description and Budget Item Justification: This project will mature and demonstrate affordable next generation training and simulation systems that focus on integrating virtual threats, asymmetric warfare, network-centric operations, and embedding training capabilities and technologies into operational go-to-war Future Force (FF) systems to include dismounted warrior systems. This project will use simulation techniques and tools that include computer generated forces, virtual terrain databases, and small image generators to create virtual training environments that include virtual opposing forces that can be detected and engaged by operators of go-to-war systems. Embedding simulation-based training technologies into combat vehicles and dismounted Soldier systems will enrich the Army's training capabilities and readiness. It will provide Soldiers, crews, and small unit leaders whose operational systems are located at home-station or deployed to remote locations worldwide with the ability to use those systems as training and mission rehearsal tools. This project will create a joint environment by synchronizing virtual and constructive simulated forces with the next generation and current training systems from the Army, Navy, Air Force, and Marine forces. These next generation training systems will contain embedded wireless technologies that connect mounted and dismounted Soldiers and other weapon systems to support distributed combined arms team training. The synergy between these embedded training capabilities and the immersive training advanced technology development in project S28 will provide Army units with a set of complementary embedded and deploy on-demand systems that provide just-in-time, dynamic, realistic training, and mission rehearsal capabilities. Demonstrations will include technologies that form a framework for future training applications for the range of FF operations such as robotic control and other sensor operations; mission planning and rehearsal; command, control, and maneuver; Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) network analysis to support distributed simulations; and vehicle system interface requirements. This project was established to transition basic and applied research from PE 0602308A, project C90 (Advanced Distributed Simulation). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Research, Development, and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Embedded Techniques: In FY06, matured and demonstrated an integrated mounted and dismounted embedded training system that includes collaborative mission planning, rehearsal, and After Action Review capabilities. In FY07, create an embedded prototype capability supporting future systems demonstrating a live, virtual, and constructive training and mission rehearsal capability. Demonstrate human-terrain annotation for representation of cultural characteristics in military constructive simulation. In FY08, will conduct experiments with embedded training common components and will develop user interfaces to support deployable mission planning and rehearsal. Will mature and demonstrate the use of instructional development tools for adaptive learning environments. In FY09, will demonstrate an embedded training mission rehearsal capability using on current force vehicles and dismounted Soldiers in field exercise to mitigate risks associated with fielding embedded training in Future Force, Current Force, and ground Soldier systems. Will develop technologies associated with common embedded training components to provide a common implementation strategy.	1444	1654	3774	3916
Small Business Innovative Research/Small Business Technology Transfer Programs		48		
Total	1444	1702	3774	3916

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**	**S31**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
S31 MATREX	10478	11141	10116	10175	11266	11347	11597	11852

A. Mission Description and Budget Item Justification: The project Modeling Architecture for Technology, Research, and EXperimentation (MATREX) provides the foundation for the distributed modeling and simulation (M&S) environment employed to reduce program cost, schedule, and technical risk across the Army's acquisition programs. MATREX provides a unifying M&S architecture, supporting tools, and infrastructure that ease the integration and use of multi-resolution live, virtual, and constructive (LVC) applications. MATREX provides capabilities to support the examination of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) concepts and system-of-systems (SoS) solutions at the entity level to facilitate studies and technology demonstrations that assess the operational impact of Network-Centric Warfare (NCW) concepts and technologies. MATREX creates a simulation environment that adequately models the Current and Future Force tactical network systems, the information that flows through that network (communications representation), and the impact of this information on force effectiveness. Efforts include the creation of a continuously available secure Distributed Virtual Laboratory (DVL) that will be used for collaborative design, development, integration, test, and execution of simulation experiments, studies, and analyses with geographically dispersed command elements and Cross Command Collaboration Effort (3CE) network partners. These partners include the Research, Development, and Engineering Command (RDECOM), Army Test and Evaluation Command (ATEC), and the Army Training and Doctrine Command (TRADOC). MATREX supports the development and selection of "best of breed" high-resolution engineering-level models to support the evaluation of Future Force (FF) concepts to include dismounted warrior systems. Integration of high-resolution engineering-models within the MATREX architecture will provide the framework to operate a true multi-resolution environment that can scale to the FF brigade combat team operations, enhancing the user's ability to study the measures of effectiveness. This project supports the partnership with the other 3CE members in the development and use of MATREX to establish a common environment that supports development, training, and testing within the community for the development and evaluation. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is led by the Research, Development, and Engineering Command (RDECOM), Systems of Systems Integration (SOSI), Fort Belvoir, VA, and executed across the Command.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
MATREX: In FY06, delivered MATREX to TRADOC including incremental updates that represent Network Effects Command and Control capabilities and Human-Centered Information Distribution to support evaluation of Network Centric Warfare. Supported FF development of Network, Effects, Maneuver, and Intelligence, Surveillance, and Reconnaissance (ISR) capability critical to the development of FF Integration and Verification Phase I architecture and milestones Advanced cross-Army M&S capability and re-use by maturing initial common data definitions. Developed a transition plan toward an interoperable cross-command and LSI environment for M&S. In FY07, deliver MATREX interoperable environment and integrated tool suite to TRADOC and ATEC. Integrate Maneuver Command and Control, Logistics, and environment capabilities. Enhance capability for end-to-end analysis in an environment that integrates NCW capabilities to support decision making. Implement more robust system-level verification and validation (V&V) of MATREX. Transition existing MATREX One Semi-Automated Forces (OneSAF) Testbed Baseline (OTB) based capabilities to an OneSAF Objective System (OOS) capability. In FY08, will extend MATREX capabilities to fully implement the TRADOC Integrated Process 3 (IP03) (Networked Fires, ISR, Battle Command, etc.) operational thread, and fully integrate weather, chemical-biological effects with complimentary human-behavior enabled Battle Command. In FY09, will increase MATREX scalability across all capabilities to	10478	10831	10116	10175

model a FF brigade combat team. Will update Simulation Initialization capability to shorten event setup time. Will implement a cross command data collection and analysis tools capability to provide an integrated acquisition support capability for Army decision making.				
Small Business Innovative Research/Small Business Technology Transfer Programs		310		
Total	10478	11141	10116	10175

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603103A - Explosive Demilitarization Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	20459	25640	10349	10632	11049	11270	11518	11771
D51	Explosives Demil Tech	20459	10262	10349	10632	11049	11270	11518	11771
D91	EXPLOSIVE DEMIL DEMONSTRATIONS		15378						

A. Mission Description and Budget Item Justification: This program element supports the Explosive Demilitarization Technology Program. Project D51 provides a cooperative interservice, interagency effort dedicated to the maturation of safe, efficient, and environmentally acceptable processes for the closed disposal of conventional munitions including explosives, missiles, missile components, and large rocket motors. Efforts in this program emphasize environmentally compliant technologies to enhance existing methods for munitions resource recovery and recycling (R3) and treatment, and seek alternatives to open burning/open detonation (OB/OD). There are currently nearly 400,000 tons of conventional munitions requiring disposition with a forecast of 475,000 tons and over 275,000 missiles and missile components to flow through the stockpile between FY 2006-2010. The effort employs the highly matured technology base in the DoD Service Laboratories and Technical Centers, the Department of Energy (DOE) National Laboratories, industry, and academia. The program is integrated through the leadership of the Product Manager for Demilitarization and the Joint Ordnance Commanders Group Munitions Demilitarization/Disposal Subgroup leveraging support from the Department's Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP), the Joint DOD/DOE Munitions Technology Program, and complementary Service science and technology programs. The Technology Directorate, Defense Ammunition Center, serves as the PM Demil's technical and programmatic support staff in this effort. The program supports the R&D Technology goals of the PM Demilitarization Strategic Plan which focuses on technology transfer opportunities. The program supports an annual Global Demilitarization Symposium for the technical review and data evaluation from ongoing projects and advanced demonstrations. The PM Demilitarization R&D IPT utilizes a systematic approach for project prioritization. The program element contains no duplication with any effort within the Military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), and the Defense Technology Area Plan (DTAP). Project D91 funds congressional interest items.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603103A - Explosive Demilitarization Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	21041	10376	10429	10651
Current BES/President's Budget (FY 2008/2009)	20459	25640	10349	10632
Total Adjustments	-582	15264	-80	-19
Congressional Program Reductions		-98		
Congressional Recissions				
Congressional Increases		15550		
Reprogrammings	-582	-188		
SBIR/STTR Transfer				
Adjustments to Budget Years			-80	-19

Change Summary Explanation: Funding:

Nine FY 2007 congressional adds totaling $14905 (after adjustment for Congressional undistributed reductions) were added to this PE.

($1,868K) - Combined Bomb Unit Decasing
($959K) - Contained Static Rocket Motor
($3,834K) - Demilitarization of Hazardous Munitions
($2,109K) - Demilitarization of Obsolete Munitions
($1,246K) - HMX Requalification Program
($1,917K) - MRC-Ammonium Perchlorate Recycling and Reuse
($959K) - MRC-Letterkenny Munitions Center
($1,054K) - Sierra Army Depot-Cryofracture/Plasma Arc System
($959K) - Small Rocket Motor Disposal

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603103A - Explosive Demilitarization Technology**	**D51**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
D51 Explosives Demil Tech	20459	10262	10349	10632	11049	11270	11518	11771

A. Mission Description and Budget Item Justification: The Explosive Demilitarization Technology Program is a cooperative interservice, interagency effort dedicated to the maturation of safe, efficient, and environmentally acceptable processes for the closed disposal of conventional munitions including explosives, missiles, missile components, and large rocket motors. Efforts in this program emphasize environmentally compliant technologies to enhance existing methods for munitions resource recovery and recycling (R3) and treatment, and seek alternatives to open burning/open detonation (OB/OD). There are currently nearly 400,000 tons of conventional munitions requiring disposition with a forecast of 475,000 tons and over 275,000 missiles and missile components to flow through the stockpile between FY 2006-2010. The effort employs the highly matured technology base in the DoD Service Laboratories and Technical Centers, the Department of Energy (DOE) national laboratories, industry, and academia. The program is integrated through the leadership of the Product Manager for Demilitarization and the Joint Ordnance Commanders Group Munitions Demilitarization/Disposal Subgroup leveraging support from the Department's Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP), the Joint DOD/DOE Munitions Technology Program, and complementary Service science and technology programs. The Technology Directorate, Defense Ammunition Center, serves as the PM Demil's technical and programmatic support staff in this effort. The program supports the R&D Technology goals of the PM Demilitarization Strategic Plan which focuses on technology transfer opportunities. The program supports an annual global demilitarization symposium for the technical review and data evaluation from ongoing projects and advanced demonstrations. The PM Demilitarization R&D IPT utilizes a systematic approach for project prioritization. The program element contains no duplication with any effort within the Military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), and the Defense Technology Area Plan (DTAP).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Resource Recovery and Reuse (R3): In FY06, continued development of calibration curves for the Near Infrared (NIR) propellant scanner; completed demonstration/validation of NIR explosives detection unit; continued conversion of gun propellant to small arms ammunition (SAA) propellant for military applications; transitioned Explosive D conversion process; completed validation of the propellant conversion technology for optimal throughput. In FY 07, transition NIR explosive detection unit and begin testing/integration for detection of 105MM projectiles; initiate optimization of propellant conversion technology, and continue Joint Program integration. In FY08, will research additional energetics and propellants for the NIR scanners and complete machine vision integration; will demonstrate optimized propellant conversion to fertilizer technology; will initiate the integration of abrasive waterjet and induction heating for 60MM mortars (DIHME: Demilitarization by Inductive Heating Meltout), and will continue Joint Program integration. In FY09, will initiate development of machine vision for other projectiles; will initiate transition of propellant conversion to fertilizer technology; will complete integration and perform preliminary testing of 60MM mortar DIHME project; will continue research and development alternatives for ammonium perchlorate; and will continue Joint Program integration.	4986	5859	4295	4621
Advanced Destruction: In FY06, demonstrated/validated enhanced stationary contained detonation technology (CDT); continued permitting of transportable CDT. In FY 07, transition stationary CDT; initiate demonstration of transportable CDT; perform hydrolysis test for Cartridge Actuated Device/Propellant Actuated Device (CAD/PAD). In FY08, will continue demonstration of transportable contained detonation technology; will continue development of characterization data for CAD/PAD technology; will initiate integration of	2171	1248	1800	1910

Particle Aerosol Mass Spectrometry (PAMS) into OB/OD operations. In FY09, will complete transition of transportable contained detonation technology; will continue testing and development of CAD/PAD technology; will perform testing of PAMS.				
Waste Stream Treatment: In FY06, validated SCWO technology; completed MSO validation and continued advanced development of MSO for explosives. In FY07, conduct extended demonstration and initiate transition of MSO. In FY08, will transition MSO technology for demil execution; will optimize throughput of MSO for explosives; will initiate development of waste water treatment for ammonium perchlorate. In FY09, will complete design of waste water treatment for ammonium perchlorate.	530	968	1766	900
Advanced Munitions Disassembly: In FY06, completed demonstration/ validation of robotic disassembly for ADAM projectile; designed and fabricated waterjet prototype for medium caliber projectiles. In FY07, initiate transition of robotic disassembly of ADAM projectile; explore recycling/disposal methods for spent abrasive in the abrasive waterjet technology and optimize nozzle performance. In FY08, will finalize transition of robotic disassembly of ADAM projectile; will transition waterjet technology to the DIHME project for 60MM mortars; will explore development of a disassembly system for the Stinger missile. In FY09, will initiate design and fabrication of disassembly system for Stinger missile.	1260	1898	1822	1150
Advanced Removal: In FY06, designed and fabricated induction heating prototype for medium caliber projectiles and tranistioned to the DIHME project for FY08. In FY08 will initiate development of a washout system for MLRS motors. In FY09, will complete design and initiate fabrication of washout technology for MLRS motors; will explore washout of insensitive explosives.	1174		666	2051
This one-year congressional add is to support an integrated Cryofracture/Plasma Arc capability. Design parameters are being tested with this funding. No additional funds are required to complete this project.	2460			
This one-year congressional add for the HMX Requalification Program will refine explosives recovery process and test the recovered explosives for reuse. No additional funds are required to complete this project.	1359			
This is a one-year congressional add for NAVAIR Systems Command Data Conversion. No additional funds are required to complete this project.	1260			
This one-year congressional add for the Western Area Demilitarization Facility is furthering development of closed disposal technologies, specifically for advanced incineration, size reduction and recycling of energetics. No additional funds are required to complete this project.	5259			
Small Business Innovative Research / Small Business Technology Transfer Programs		289		
Total	20459	10262	10349	10632

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603105A - MILITARY HIV RESEARCH**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	12839	12897	6998	7162	6814	6944	7097	7253
H29	MED PROTECT AGNST HIV	12839	6964	6998	7162	6814	6944	7097	7253
T16	MILITARY HIV INITIATIVES CA		5933						

A. Mission Description and Budget Item Justification: This project matures and demonstrates advanced technology development of candidate vaccines to include safety and efficacy (effectiveness) to prepare and conduct human clinical studies. It funds human immunodeficiency virus (HIV) research to control the infection in military environments, protect the military blood supply, and protect military personnel from risks associated with infection. All HIV technology development activities are conducted in compliance with US Food and Drug Administration (FDA) regulations and conducted under an Investigational New Drug (IND) application with the FDA. The FDA requires thorough testing in animals (referred to as preclinical testing) to assure safety and efficacy prior to approving controlled clinical testing of experimental (previously unproven in humans) drugs, vaccines, and medical devices in humans. Normally clinical trials are conducted in three phases (Phase 1, 2, and 3) to prove safety and effectiveness of the drug/vaccine/device for the targeted disease/condition. An increasing number of people are used in each subsequent phase. All test results are submitted to the FDA for evaluation to obtain approval for routine medical use. This program is jointly managed through an Interagency Agreement by the US Army Medical Research and Materiel Command and the National Institute of Allergy and Infectious Diseases. This project contains no duplication with any effort within the Military Departments or other government organizations. Work is related to and fully coordinated with work funded in program element (PE) 0602787, project 873. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Walter Reed Army Institute of Research (WRAIR), Rockville, MD, and its overseas laboratories; and the Naval Medical Research Center (NMRC), Silver Spring, MD, and its overseas laboratories. Most work is conducted under a cooperative agreement with the Henry M. Jackson Foundation (HMJF), Rockville, MD.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603105A - MILITARY HIV RESEARCH**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	13644	7042	7052	7175
Current BES/President's Budget (FY 2008/2009)	12839	12897	6998	7162
Total Adjustments	-805	5855	-54	-13
Congressional Program Reductions		-49		
Congressional Recissions				
Congressional Increases		6000		
Reprogrammings	-805	-96		
SBIR/STTR Transfer				
Adjustments to Budget Years			-54	-13

In FY07, a Congressional Add listed under Project T-16 (Military HIV Initiatives) in the amount of $6M is being used to support ongoing HIV research efforts.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603105A - MILITARY HIV RESEARCH**	**H29**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H29 MED PROTECT AGNST HIV	12839	6964	6998	7162	6814	6944	7097	7253

A. Mission Description and Budget Item Justification: This project matures and demonstrates advanced technology of candidate human immunodeficiency virus (HIV) vaccines, prepares and conducts human clinical studies to assess safety and efficacy (effectiveness) of candidate HIV vaccines, conducts research to control HIV infection in military environments, protect the military blood supply, and protect military personnel from risks associated with HIV infection. All HIV technology development activities are conducted in compliance with US Food and Drug Administration (FDA) regulations and conducted under an Investigational New Drug (IND) application with the FDA. The FDA requires thorough testing in animal models (preclinical testing) to assure safety and efficacy prior to approving controlled clinical testing of drugs, vaccines, and medical devices in humans. Normally clinical trials are conducted in three phases (Phase 1, 2, and 3) to prove safety and effectiveness of the drug/vaccine/device for the targeted disease/condition. An increasing number of people are used in each subsequent phase. All test results are submitted to the FDA for evaluation to obtain approval for routine medical use. This program is jointly managed through an Interagency Agreement by the US Army Medical Research and Materiel Command and the National Institute of Allergy and Infectious Diseases. This project contains no duplication with any effort within the Military Departments or other government organizations. Work is related to and fully coordinated with work funded in program element (PE) 0602787, project 873. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the Walter Reed Army Institute of Research (WRAIR), Rockville, MD, and its overseas laboratories; and the Naval Medical Research Center (NMRC), Silver Spring, MD, and its overseas laboratories. Most work is conducted under a cooperative agreement with the Henry M. Jackson Foundation (HMJF), Rockville, MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
HIV Program: Complete preclinical testing (studies required by the FDA prior to testing in humans), and conduct manufacturing and clinical studies of HIV vaccine candidates. In FY06, conducted activities required for vaccine development such as safety testing in animals, manufacturing of pilot lot of vaccine for clinical testing in 50-100 human subjects, and validation of new tests as required by the FDA. Supported current clinical program with three clinical trials completed, four trials active, and planning for five future clinical trials. In FY07, conduct vaccine maturation and clinical studies including transition to the next phase of clinical testing (Phase 2) of two vaccines involving up to 300 human subjects and long-term (up to three years) follow up of subjects from completed trials; continue activities required to support HIV vaccine development including regulatory reporting on conduct of clinical trials to the FDA; assess clinical materials to understand responses to vaccines; and maintain clinical trial facilities in the US and international field trial sites in Kenya, Uganda, and Tanzania. In FY08, will continue with HIV vaccine development and clinical testing of new candidate vaccines including maintaining the facilities required to assess clinical samples and to show vaccine safety and effectiveness; will continue long-term clinical follow up of vaccinated subjects; and will continue to develop and maintain new clinical trial sites in Africa and Asia to maintain a sufficient base of potential subjects for testing of vaccines under development by the U.S. government. In FY09, will continue to assess ongoing vaccine trials to select promising candidates, stop efforts on vaccines that are not safe or effective, and continue activities in support of vaccines under development.	6132	6768	6998	7162
HIV Research: This one year congressional add funded additional research on, and preclinical testing of, a DNA-based vaccine candidate co-developed with the National Institute of Allergy and Infectious Diseases. Additionally, it supported preparation of several African field	6707			

test sites for clinical trials with this vaccine, which required the establishment of clinics, laboratory facilities, and training of personnel to conduct these trials.				
Small Business Innovative Research/Small Business Technology Transfer Programs		196		
Total	12839	6964	6998	7162

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603125A - Combating Terrorism, Technology Development for**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	9528	8503	13061	13148	13278	12761	12832	13206
DF3	CONSEQUENCE MANAGEMENT & RECOVERY	3834	1088						
DF5	AGILE INTEGRATION & DEMONSTRATION	5694	7415	13061	13148	13278	12761	12832	13206

A. Mission Description and Budget Item Justification: The objective of this program element (PE) is to mature and demonstrate advanced survivability technologies against asymmetric threats in support of the Future Force and, where feasible, exploit opportunities to enhance Current Force. This PE also funds efforts to accelerate technologies with high payoff to address current operational shortfalls and assist deliveries of Future Force oriented projects into current operations capabilities. Survivability and Denial, project DF1, demonstrates a survivability planning capability and lightweight low-cost blast/ballistic protective measures. This increases base camp survivability of personnel and equipment against advanced conventional weapons and terrorist threats, reduces logistics requirements, and enhances the capability of the Future Force in low-intensity conflicts and peacekeeping operations. Projects DF2, DF3, and DF6 fund congressional special interest items. Agile Integration and Demonstration, project DF5, funds critical technology acceleration efforts of selected high-payoff technologies emerging from work in other PEs that have potential to fill emerging capability gaps requiring immediate action. The cited work is consistent with Strategic Planning Guidance, Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE is performed by the US Army Engineer Research and Development Center headquartered at Vicksburg, MI and Research, Development, and Engineering Command (RDECOM), Ft. Belvoir, VA.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603125A - Combating Terrorism, Technology Development for**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	10159	7497	8102	8280
Current BES/President's Budget (FY 2008/2009)	9528	8503	13061	13148
Total Adjustments	-631	1006	4959	4868
Congressional Program Reductions		-32		
Congressional Rescissions				
Congressional Increases		1100		
Reprogrammings	-631	-62		
SBIR/STTR Transfer				
Adjustments to Budget Years			4959	4868

FY08 and FY09 funding increased to support an OSD directed Power and Energy Security effort.

One FY07 congressional add totaling $1055 after adjustment for undistributed Congressional reductions was added to this PE.

($1055) Advanced Mobile Micro Grid Program

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603125A - Combating Terrorism, Technology Development for**	**DF5**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
DF5	AGILE INTEGRATION & DEMONSTRATION	5694	7415	13061	13148	13278	12761	12832	13206

A. Mission Description and Budget Item Justification: This project allows the Army to exploit emerging technology from across the Army Research Community and focus those technologies on addressing current warfighter needs. Efforts derive from successes of the Research, Development, and Engineering Command (RDECOM), the Army's Corps of Engineers Research and Development Center, the Medical Research Materiel Command, and the Space and Missile Defense Command. Successes emerging from Department of Energy (DOE) Laboratories are also potential AIDE projects this year. This effort allows research activities to team with Program Managers and the Rapid Equipping Force to accelerate technology maturation and ready technologies to transition to the operational environment. Short term maturation could include, but is not limited to, accelerating the technology development schedule and/or performing detailed safety and validation tests in field/operational environment testing to improve technology readiness. While not limited to these areas, major efforts under this project support the accelerated maturation of counter terrorism capabilities (detection, surveillance of deployment, and disruption/destruction of threat), and Soldier and Force Protection measures and well as emerging Energy Surety technologies for transition into an operational environment. Supported requirements are approved by TRADOC or the combatant commanders. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan, the Army Modernization Plan, and the Defense Technology Area Plan. Work in this project is managed by the US Army Research, Development, and Engineering Command, Ft. Belvoir, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, the first year of this project, the RDECOM solicited proposals from its component labs and centers, and selected eight proposals for funding from the 65 proposals received. Major efforts support the accelerated maturation of counter terrorism technologies, force protection efforts, and enhanced Soldier capabilities. These projects include, but are not limited to; the addition of an explosives detection arm onto the Husky route clearance vehicle for roadside explosives detection; a new add-on ballistic neck and throat protection to the combat helmet to reduce combat casualties from small arms and blast fragmentation; significant operational enhancements to the Mobile RAID surveillance system, including integrated navigation, FBCB2, UTAMS, and voice communications followed by an in-theater evaluation; and the development of game based software programs providing enhanced soldier training systems, to include the Every Soldier a Sensor (ES3) training system and a Tactical Combat Casualty Care (TC3) training system to provide combat medics a virtual environment for realistic, tailorable training.	5694			
In FY07, complete maturation, demonstration, and evaluation of FY06 efforts ($1.4M), in preparation for transition to operational units. Solicit new technology proposals, review, and select most relevant programs for funding. The FY07 program will contain technology projects to continue the maturation of counter terrorism technologies, provide enhanced force protection, introduce medical life saving projects, and provide enhanced Soldier capabilities. Planned force protection programs include adding armor to provide additional protection to route reconnaissance vehicles and to build prototypes and conduct operational testing of vehicle mounted non-lethal systems. Medical technologies include development of a small, easily portable oxygen concentrator for patient treatment and transport. Soldier and operational enhancements include the creation of a PC-based Bi-Lateral Negotiation Environment Simulation (BLNE) to provide realistic comprehensive language and cultural training for Soldiers and officers deployed to a foreign country.		7207		

In FY08, will complete maturation, demonstration, and evaluation of FY07 efforts in preparation for transition to operational units, approximately $4M. This program will continue to identify maturing technologies from within all Army R&D activities and the DOE, to accelerate the development of suitable technologies to the warfighter for demonstration and experimentation. Emphasis will continue to be on those areas that provide the operational forces increased protection and survivability, and meet the Operational Need Statements of the deployed forces in OEF and OIF. In FY09 will complete maturation, demonstration and evaluation of FY08 efforts in preparation for transition to operational units. Will identify and mature through prototype development and testing of additional new technologies from all sources that can be accelerated to overcome the changing capability gaps and requirements shortfalls experienced by operational forces around the globe.			8000	8257
The Rapid Equipping Force (REF) is developing a Transportable Hybrid Electric Power Station (THEPS). THEPS will incorporate solar technology, wind technology, advanced storage technology, and intelligent power management technology to reduce use of fossil fuel generators. Intent of these alternative power sources is to reduce the tether of fuel resupply. There is a pressing need to continue R&D to integrate advanced technologies into THEPS. In FY08, spiral development of more efficient photovoltaic technology, wind technology, and more advanced algorithms for intelligent power management will be incorporated to provided larger size (10kw and 15kw) THEPS. Larger size THEPS will allow more flexibility to support remote operations, tactical command posts, and temporary Forward Operating Bases (FOB) with less logistics tail and more cost avoidance as a result of consuming less fossil fuel. In FY09, develop and demonstrate 10-15kw THEPS and will network THEPS into an intelligent power grid to provide more efficiencies and redundancies. Field test THEPS at remote sites and operating bases.			5061	4891
Small Business Innovative Research/Small Business Technology Transfer Programs		208		
Total	5694	7415	13061	13148

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603270A - EW TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	21564	25280	17419	18864	19402	18780	19193	19615
K12	EW Demonstrations (CA)	9392	6874						
K15	ADVANCED COMM ECM DEMO	7705	9321	9395	9356	9451	9542	9752	9966
K16	NON-COMMO ECM TECH DEM	4467	9085	8024	9508	9951	9238	9441	9649

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates electronic warfare (EW) survivability and combat identification systems to significantly enhance the survivability, lethality, and ability to conduct offensive operations to win the information war for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities to include combat identification. It addresses the need to locate, disrupt, or destroy the enemy's Command, Control, and Communications (C3) systems and infrastructure, tactical radar surveillance and radio frequency (RF)/infrared (IR)/electro-optical (EO) homing, guided, and directed munitions and missile systems. Communications countermeasures (CM) and communications counter-countermeasures (CCM) applications are matured to deny the enemy the use of their sensors while protecting sensors from enemy deception and jamming. Project K15, The Advanced Communications Electronic Countermeasures (ECM), provides technology demonstrations in CM, information collection and reporting to transition to Army intelligence and electronic warfare (IEW) systems. Project K16, Non-communication ECM Technology Demonstration, focuses on the feasibility and effectiveness of non-communications ECM and electronic support/electronic intelligence. This project provides self-protection from radar, (EO), and (IR) guided anti-aircraft artillery, surface-to-surface missiles, artillery, and top attack weapons. Further, it provides precise targeting information on non-communications emitters. Deception and jamming of the enemy through long range netted sensor webs will assist in neutralizing the enemy's ability to see, understand, decide, and shoot first. RF based detection and jamming techniques will be matured, in coordination with on-going IR sensor research, to protect ground forces against command and sensor-initiated threats. Efforts in this PE are coordinated with PE 0603313 (Missile and Rocket Advanced Technology) and PE 0603003A (Aviation Advanced Technology), PE 0602270 (EW Techniques), PE 0602120 (Sensors and Electronic Survivability), and PE 0603772 (Advanced Tactical Computer Science). Projects K12, K19, and K20 fund congressional special interest efforts.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0602270A (EW Technology). Work in this PE is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center, Fort Monmouth, NJ.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603270A - EW TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	22280	18612	18857	18898
Current BES/President's Budget (FY 2008/2009)	21564	25280	17419	18864
Total Adjustments	-716	6668	-1438	-34
Congressional Program Reductions		-97		
Congressional Rescissions				
Congressional Increases		6950		
Reprogrammings	-716	-185		
SBIR/STTR Transfer				
Adjustments to Budget Years			-1438	-34

Five FY07 congressional adds totaling $6661 (after adjustment for Congressional undistributed reductions) were added to this PE.

($1534) US Army Tactical ELINT for Grnd Maneuver Forces
($1773) Portable Level I Fusion Tool Set
($958) Aerial Canopy MASINT Sensor (ACMS)
($958) Advanced IED Jammer R&D Program
($1438) WIZARD - Remotely Controlled IED CM for DM Soldier

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603270A - EW TECHNOLOGY**	**K15**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
K15 ADVANCED COMM ECM DEMO	7705	9321	9395	9356	9451	9542	9752	9966

A. Mission Description and Budget Item Justification: This project matures and demonstrates the ability to locate and identify modern tactical battlefield enemy and blue force radio frequency (RF) communications and radars for the Future Force to conduct uninterrupted air and ground based intelligence collection and long range targeting operations in a hostile electromagnetic environment. This project provides flexible, modern systems to achieve information dominance, protect the force, and shape the battlespace. Networked Electronic Warfare (NEW) will provide lightweight, low cost Unmanned Aerial Vehicle (UAV), and Unattended Ground Sensors (UGS) Electronic Support Measures (ESM) to detect and locate modern signals of interest. This project investigates, researches, and demonstrates communications countermeasures (CM) and counter-countermeasures (CCM) technologies to first intercept, identify, and locate tactical communications and then manipulate threat computer networks and their components.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering Center, Ft. Monmouth NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Networked Electronic Warfare: This effort provides autonomous detection, classification, correlation, and geo-location capability against modern wireless emitters and other threats. In FY06, demonstrated UAV and UGS electronic support measures (ESM) with real time collection, identification, and location; matured situational awareness algorithms, traffic analysis algorithms, and electronic attack capabilities for signals of interest; matured and demonstrated adaptive array processor for geolocation of signals of interest. In FY07, demonstrate UAV and ground-based ESM systems in a high emitter density suburban and urban operational environment; transition ESM systems to Program Manager Signal Warfare; mature wideband antenna and power amplifiers that cover multiple octaves jamming; continue development of adaptive array processor to counter problems associated with multipath, co-channel, and co-site interference; mature software algorithms to map present communications architecture in areas of interest; perform analysis to determine the optimal network based attack schema. In FY08, will conduct developmental tests and operational assessment; will continue to refine system design and integrate complementary jamming and detection/location/neutralization capabilities; will integrate wideband antenna into adaptive array; integrate algorithms into government off the shelf hardware. In FY09, will integrate commercial off the shelf 3-D visualization and mapping tools with geo-location solution set for optimal urban situational awareness and emitter representation; will integrate capabilities into net-centric solution that combines jamming and detection/locations/ neutralization capabilities; will complete algorithm development and validation and fabrication of adaptive processing arrays. Work related to this effort is also being accomplished under PE 62270 projects 442 and 906 and PE 63270 project K16.	7705	9122	9395	9356
Small Business Innovative Research/Small Business Technology Transfer Programs		199		
Total	7705	9321	9395	9356

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603270A - EW TECHNOLOGY**	**K16**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
K16	NON-COMMO ECM TECH DEM	4467	9085	8024	9508	9951	9238	9441	9649

A. Mission Description and Budget Item Justification: This project matures and demonstrates the Future Force non-communication, multi-functional electronic warfare capability to enhance the survivability of aviation platforms, ground combat vehicles, and the dismounted forces. The survivability approach will provide detection avoidance through situational awareness and identification technologies, signature management, hit avoidance using warning receivers, and electronic countermeasures. This project demonstrates recent advances in radio frequency (RF), infrared (IR) and electro-optical (EO) sensor and jamming sources to detect, locate, deceive, and jam booby traps, radar directed target acquisition systems, target-tracking sensors, surface-to-air missiles (SAMs), air-to-air missiles (AAMs), top attack and electronically fuzed munitions. The ability to neutralize booby traps will be matured and demonstrated by embedding the maximum capability in projected brigade combat team (BCT)/Future Force systems to minimize vehicle weight, cost, logistics, and fielding. Additionally, this project will demonstrate EO technologies and countermeasure technologies against laser-aided and electro-optically directed gun or missile systems. This project also demonstrates Electronic Support (ES) technologies used against communications and non-communications signals for targeting, combat identification, and tactical Situation Awareness (SA). Efforts are focused on detecting, identifying, and geolocating emitters of interest from an effective standoff distance and providing near real-time SA updates to the BCT commander.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications-Electronic Research, Development, and Engineering Center, Ft. Monmouth NJ, and the Army Research Lab, Adelphi MD.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Networked Electronic Warfare: This effort provides autonomous detection, classification, correlation, and geo-location capability against modern wireless emitters and other threats. In FY06, investigated the effects of radio frequency (RF) energy on electronic triggers for threats and measured the power/modulation required to dud or otherwise neutralize selected devices; developed power/energy requirements for neutralization concepts and design parameters. In FY07, develop counter threat prototypes and algorithms, including unique waveforms, antennas, high sensitivity receivers, and high power transmitters for threat detection and neutralization technologies. In FY08, will integrate algorithms into government off the shelf hardware; will conduct performance testing of prototype system; will continue to refine the system design based on test results and begin integration of jamming and detection/location/neutralization capabilities. In FY09, will complete algorithm development and validation and fabrication of adaptive processing arrays; will integrate visualization and mapping tools with geolocation solution sets; will demonstrate capability in the lab. Work related to this effort is also being accomplished under PE/Project: 62270/442; 62270/906, and 63270/K15.	2330	1989	2066	2230
Cueing Sensor: This effort matures and demonstrates low cost infrared sensors that detect rocket propelled grenades, anti-tank guided missiles, and tank fired kinetic energy and high energy anti-tank rounds and then cue active protection system for Army vehicles. In FY07, mature dual band focal plane arrays (FPA), algorithms, and signal processing; perform live-fire test of prototype warning and cueing sensors and systems; select one system based on test results. In FY08, will optimize FPA design; will enhance sensor, electronics, and algorithms for testing on-the-move (OTM) environment. In FY09, will demonstrate the cueing sensor software and hardware against		1926	3600	7278

different types of live fire munitions (threats to ground vehicle); will demonstrate the capability to detect, declare, and classify the live fire threats; will transition the cueing sensor hardware and software to the active protection system (APS) effort for integration into the kinetic energy APS vehicle survivability system. Work related to this effort is also being accomplished under PE/Projects: 62270/442; 62120/H15; and 63772/243.				
Combat Identification Technologies: In FY06, matured custom application specific integrated circuits (ASICs) for millimeter wave (mmW) identification (ID) functionality; demonstrated tools for determining cost effectiveness of combat identification (CID) capabilities; matured modeling and simulation of CID concepts. In FY07, design and fabricate geometric pairing (GP) and RF Tag hardware for the ground Soldier to demonstrate dismounted integration concepts and technical performance characteristics; conduct first technical testing of GP situation awareness and RF Tag concepts and complete inserting mmW ID functionality into custom ASICs. Work related to this effort is also being accomplished under PE/Project 62120/H15.	1350	1078		
Hostile Fire Indication (HFI) and Countermeasure (CM): This effort implements affordable hostile fire indication for aircraft against small arms fire and rocket propelled grenades (RPG) by modifying currently fielded systems. In FY06, initiated aircraft and threat modeling and simulation for tactics, techniques, and procedures development, modified Common Missile Warning System (CMWS) processor to enable small arms detection. In FY07, investigate RPG detection with CMWS; modify the APR-39A(V)1 Radar Warning System software to display HFI warnings; mature modeling and simulation of sensor and threats; leverage UK/USAF/NVESD optical CM for small arms and RPGs. In FY08, will complete software modifications to cockpit display HFI display interface; will define overall suite architecture for net-centric survivability in a Simulation environment; will conduct live fire test to demonstrate CMWS processing upgrades for hostile fire indication and countermeasure; will transition technology to Aviation and Missile Research, Development, and Engineering Center aircraft survivability program for flight testing.	787	3880	2358	
Small Business Innovative Research/Small Business Technology Transfer Programs		212		
Total	4467	9085	8024	9508

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	113079	62940	60353	64398	71248	71105	67042	65585
206	MISSILE SIMULATION	9771	3383	3481	3556	3591	3618	3698	3779
263	FUTURE MSL TECH INTEGR(FMTI)	40159	9380	31119	37158	49335	48919	45907	46917
550	COUNTER ACTIVE PROTECTION	16294	12262	15395	15496	8278	5691	5816	5944
655	HYPERVELOCITY MISSILE TD	11608							
704	Advanced Missile Demo	6589	2956	8373	6189	8000	10800	8500	6742
G03	Army Hypersonics Advanced Technology			1985	1999	2044	2077	3121	2203
NA6	Missile and Rocket Initiatives (CA)	28658	34959						

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates advanced missile technologies to enhance weapon system lethality, survivability, agility, deployability, and affordability for the Future Modular Force and, where feasible, exploits opportunities to enhance Current Force capabilities. (Note that FY08 represents a funding amount more closely resembling established levels. The ramp down in FY07 is largely the result of the successful completion and transition of three major 6.3 efforts in FY06: Non-Line-of-Sight Launch System (NLOS-LS) completion and spiral of the enhanced Precision Attack Missile (ePAM) to the project office; successful completion of the Compact Kinetic Energy Missile (CKEM) ATD, and successful completion of the Close-In Active Protection System (CIAPS) effort. The ramp up in FY08 is due to the progression of 6.2 efforts to 6.3, including Close Combat Networking of Weapons and Systems, Defense against Rockets, Artillery, and Mortars (RAM), and Counter RAM Tracking and Fire Control.) Efforts are conducted through system simulation, design, demonstration, and test in both laboratory and operational scenarios. This PE includes demonstrations of advanced tactical missiles, real-time hardware-in-the-loop simulations, and ground system survivability efforts. The technologies focused on in this PE enhance the warfighting capabilities for locating targets in clutter, precision guidance, hypervelocity missile flight, and missile communications, command, and control. The major efforts in this PE are the Non-Line-of-Sight Launch System (NLOS-LS), Advanced Multi-Mission Precision Guided Munition (AMMPGM), Active Defense for the Current and Future Force (concentrating on defense against rockets, artillery, and mortars (RAM)), Active Protection System (APS) components for ground air platforms, and development and demonstration of hypersonic missile technology. A key effort is the development of a guided interceptor to work with the APS being developed for Future Combat Systems (FCS) and the Future Force. This interceptor requires advanced technology in controls, inertial sensors, and guidance algorithms. Development and demonstration of the guided interceptor will be done in collaboration with the FCS APS developer, who will provide the tracking sensor and launch mechanism required for the development and demonstration of the guided interceptor. The Army Hypersonics Applied Research program matures and demonstrates expendable hypersonic/hypervelocity missiles and technologies for the defeat of hypersonic threats. Survivability efforts are coordinated with PE 0602303A (Missile Technology), PE 0603003A (Aviation Advanced Technology), PE 0603270A (Electronic Warfare Technology), PE 0602624A (Weapons and Munitions Technology), PE 0603004A (Weapons and Munitions Advanced Technology), and PE 0603005A (Combat Vehicle and Automotive Advanced Technology). The emphasis in this program element is on smaller, lighter weight, more affordable missiles. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	114018	42127	67167	81003
Current BES/President's Budget (FY 2008/2009)	113079	62940	60353	64398
Total Adjustments	-939	20813	-6814	-16605
Congressional Program Reductions		-14073		
Congressional Rescissions				
Congressional Increases		35350		
Reprogrammings	-939	-464		
SBIR/STTR Transfer				
Adjustments to Budget Years			-6814	-16605

FY09 funds decreased due to Army decision to reduce emphasis on hypersonic missile technology and fund higher priority Army efforts.

Eight FY07 congressional adds totaling $20846 (after adjustment for Congressional undistributed reductions) were added to this PE.

($1869) Warfighter Protection & Homeland Security Lab
($958) Smart Energetics Arch for Missile Systems
($1294) FTT50 High Efficiency Turbine Engine
($7667) Cessna Optionally Piloted Aircraft (COPA)-RSTA
($1246) Close Combat Lethal Recon (CCLR)
($1294) Compact Kinetic Energy Missile (CKEM)
($4409) Missile Sim Tech Rapid Assessment & Deployment
($2109) Permanent Magnet System

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**206**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
206 MISSILE SIMULATION	9771	3383	3481	3556	3591	3618	3698	3779

A. Mission Description and Budget Item Justification: This project matures, develops, and demonstrates modeling and simulation tools for missile design and analysis. This project accomplishes the design, expansion, and improvement of hardware-in-the-loop (HWIL) simulation capabilities. HWIL simulation is used to evaluate tactical and theater missiles and precision-guided munitions (ground-to-air, ground-to-ground, air-to-ground) guided by radar frequency (RF), millimeter-wave RF (MMW), electro-optical (EO), and passive and active infrared (IR) spectral signals. Future missile systems will use multi-mode combinations of these guidance technologies such as those envisioned for the Non-Line-of-Sight Launch System (NLOS-LS) and other systems within the Future Modular Force. Evaluation by means of HWIL provides a cost-effective method that supports missile maturation throughout weapon system life cycles and permits a reduction in the number of flight tests required, as well as improving the confidence of flight test readiness and the probability of successful flight tests. Recent developments in HWIL simulation technology have enabled these techniques to be applied to missile production lot acceptance testing and post-deployment stockpile reliability tests to reduce their costs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Missile Simulation: In FY06, matured a single-channel scanning laser radar (LADAR) for testing of LADAR sensors. Integrated digital circuit techniques to improve radio frequency (RF) millimeter wave (MMW) signal generation. Advanced capabilities for semi-active laser HWIL simulation. Completed design of an advanced passive IR scene projector for HWIL simulation including dynamic hot-spots. Demonstrated applications of low-cost Personal Computers (PC) to real-time scene modeling. Investigated and established techniques for MMW synthetic aperture radar (SAR). Designed method for rapid integration of missile seekers into a HWIL environment. In FY07, will test scanning and multi-channel LADAR projectors against a high-resolution LADAR sensor. Will complete the advanced IR projector and perform initial tests and advance the development of MMW synthetic aperture radar processing for missile guidance. Will design general-purpose interfaces using Field-Programmable Gate Arrays (FPGA) for interfacing to particular seeker designs. Will support integration and development of a multi-guidance mode HWIL capability. Will extend PC scene generation techniques to a practical application. In FY08, investigate controls to project coherent Frequency Modulated Continuous Wave (FMCW) LADAR signals. Will complete testing of the advanced passive IR projector and apply lab data to IR simulation environment for more accurate IR seeker testing. Will develop MMW signal generation techniques to include high-rate FM pulse processing and develop SAR signal processing techniques to improve output images. In FY09, will extend the LADAR projector capability to flash 2-D and coherent LADARs, and reduce background temperature and improve dynamic range for the advanced IR projector and test the prototype rapid integration-into-laboratory of seeker modules. Will continue development of MMW FM pulse processing to achieve necessary bandwidth.	3061	3291	3481	3556
Missile Simulation Technology Rapid Assessment and Deployment of Systems Initiative: This one-year congressional add funded the development of a missile simulation capability supporting a rapid assessment capability. No additional funding is required.	6710			
Small Business Innovative Research/Small Business Technology Transfer Programs		92		
Total	9771	3383	3481	3556

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**263**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
263 FUTURE MSL TECH INTEGR(FMTI)	40159	9380	31119	37158	49335	48919	45907	46917

A. Mission Description and Budget Item Justification: This project demonstrates advanced tactical missile technologies such as seekers, propulsion, airframes, and guidance and controls for missiles supporting the Future Modular Force. (Note that FY08 represents a funding level more closely resembling established levels. FY07 sees a drop from FY06 due to the reduction of the Non-Line-of-Sight Launch System (NLOS-LS) effort associated with the spiral of the enhanced Precision Attack Missile (ePAM) to the project office. Improved PAM (iPAM) and other spiral transitions continue.) These technologies include: multi-mode seekers, controllable thrust motors (gels, pintle-controlled solids, and air breathing), and aided target acquisition (ATA) for missile systems. Seeker development addresses imaging infrared, laser radar (LADAR), and millimeter wave seeker technologies, combined with semi-active laser technology, to provide precision strike and fire-and-forget guidance modes. Investigates affordable, controllable thrust rocket motors that provide longer ranges, and shorter flight times while increasing system safety and robustness in various mission roles. Matures missile guidance and electronics technologies to enable target position updates to the missiles, re-tasking orders to the missiles, and transmission of imagery to the ground for target verification and battle damage assessment. This project funds the demonstration of air defense capability for the Future Force, concentrating on active defense against rockets, artillery, and mortars using technologies funded under PE 0602303A. In addition, smaller, lighter-weight, and more affordable missile technologies are demonstrated using the technology matured under PE 0602303A. The continuing Smaller, Lighter, Cheaper (SLC) Tactical Missiles effort transitions this matured technology to reduce the cost and logistics burden of precision munitions. This program's goal is to reduce the cost per kill of precision guided missiles, through the innovative application of technology. Close Combat Networking of Weapons and Sensors (CCNW&S) demonstrates a prototype infantry networked lethality capability to dramatically improve weapon/target pairing at the squad and platoon level. This project responds to a priority US Army Infantry Center need for direct-fire range overmatch against current and future threats. This effort strives to leverage and ensure compatibility with fielded tactical systems, including weapons, sensors, displays, radios, and networks. A key project component is the addition of networked Far Target Locators (FTL) and image/data transmission capability to the Javelin Command Launch Unit (CLU) and Tube-launched, Optically-tracked, Wire-guided (TOW) Improved Target Acquisition System (ITAS). These FTLs organically calculate target coordinates and feed the infantry battle command system. Networked CLUs are to be employed in the same manner. Payoffs include increased Line-of-Sight/Beyond-Line-of-Sight lethality and overmatch made possible by synchronized sensors, fires, and maneuver in near-real time; increased warfighter survivability via early acquisition and targeting; and increased situational awareness. These provide a common operating picture for the manned platform and dismounted Soldier through the rapid sharing of actionable information. The project will also mature the technologies demonstrated and funded under PE 062303A. These efforts directly support the NLOS-LS System Development and Demonstration (SDD) program and multiple other systems managed by the Program Executive Officer for Missiles and Space. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Enhanced Seeker Development: In FY06, completed the final design of the multi-mode Precision Attack Missile (PAM) seeker, fabricated components and began component testing. Began integration of the PAM multi-mode seeker and test planning for captive flight testing. Completed the final design of the LADAR dual-mode seeker and began fabrication and component/subsystem testing. Conducted manufacturability and producibility studies of both multi-mode PAM seeker and dual-mode LADAR seeker. Integrated seeker model updates for both enhanced seekers into Integrated Flight Simulation (IFS) models to conduct system effectiveness and performance	24630	6520	2321	942

studies. Provided multi-mode seeker information to Navy Small Diameter Bomb technical leads. Developed a program plan and initiated the design and evaluation of miniaturized electronics for PAM applications (leveraging PE0602303A). Performed aided target acquisition (ATA) performance evaluations utilizing enhanced PAM (ePAM) seeker captive flight tests and LADAR captive flight test data. In FY07, complete fabrication and perform subsystem tests and system captive flight testing of the PAM multi-mode seeker. Perform ATA performance evaluations utilizing multi-mode PAM seeker captive flight test data and develop concepts, detailed designs, and begin prototype fabrication and component/subsystem testing of NLOS-LS spirals. In FY08, perform captive flight testing and final evaluation of the multi-mode PAM seeker and transition the technology as a spiral upgrade to NLOS-LS System Design and Development (SDD) phase. Will mature NLOS spiral concepts/designs. In FY09, will evaluate and mature technology and transition enhanced iPAM seeker, ATA, and electronics as a spiral upgrade to NLOS-LS SDD. Finalize testing and evaluation through technology demonstration of NLOS-LS spirals.				
Advanced Propulsion and Warheads: In FY06, performed enhanced propulsion trade studies and identified propulsion concepts and/or thrust cycle that maximize range of Precision Attack Missile (PAM). Completed design of test-bed pintle motor for advanced materials testing and began fabrication of hardware. Performed insensitive munition screening tests. Developed high efficiency turbine engine (HETE) configurations and performed design studies. Formed manufacturing and cost teams to investigate risk and benefits of productions plans. Performed trade studies to verify HETE performance. In FY07, update propulsion trades and evaluations of critical enhanced PAM propulsion subsystems for spiral insertion. In addition, conduct baseline evaluations and simulation of the HETE critical technologies. In FY08, will investigate enhanced PAM propulsion and warhead technologies and incorporate insensitive munitions PAM applications and improved PAM (iPAM) design (leverage PE0602303A). iPAM design includes improved seeker, new electronics, autopilot modifications, and evaluation of interaction with energetics modifications. Will further mature the HETE technologies through detailed design, prototype/flight-weight hardware fabrication, integration, and testing. In FY09, will continue development and maturation of enhanced PAM propulsion technologies and perform subsystem and system integration testing; and finalize maturation of HETE flight-weight hardware, and will transition to PEO Missiles and Space.	7625	866	4724	1884
Modeling/Simulation and System Performance Evaluation: In FY06, increased fidelity of models to support few-on-few simulations; performed trade studies, identified alternate variants, and critical subsystem requirements to achieve NLOS-LS Objective System performance; and addressed manufacturing and affordability (M&A) issues through system research, design, and maturation. Performed high-fidelity PAM multi-mode seeker Integrated Flight Simulations (IFS) studies to include probability of encounter, in-flight update considerations, and sensor fusion studies. Integrated scene generator with multi-mode sensor models and optimized simulation capabilities. Performed stability/controllability and kinematics/search study with updated wind tunnel test data for Loiter Attack Missile (LAM); developed visualization tools for enhanced LAM scenarios; performed high maneuverable airframe analyses and preliminary performance evaluations of turbo engine designs. In FY07, conduct preflight and post flight reconstruction of PAM captive flight tests performed and support simulation formal accreditation process. Continue trade studies taking into account various regions, targets, environments, and countermeasures, identifying alternate variants, and critical subsystem requirements. Address M&A issues and expand the envelope of conditions evaluated by the simulation. Perform trade studies and generate detailed simulation models for evaluation of NLOS-LS variant missiles. In FY08, will support few-on-few simulations and experiments. Will perform trade studies and generate detailed simulation models for evaluation of PAM propulsion technology insertion. Model M&A issues in preliminary design phase of NLOS-LS variants. In FY09, will perform many-on-many system trade studies and generate detailed simulation models for evaluation of NLOS variants and PAM upgrades while continuing to address M&A issues; conduct excursions to expand the envelope of simulation evaluated conditions.	7904	1755	2527	942
Smaller, Lighter, Cheaper (SLC): In FY08, will integrate warhead, safe and arm, and final guidance electronics unit into the Close Combat			5169	7334

Lethal Recon (CCLR) system (developed with DARPA under PE 0602303A project 214) and perform integration testing. Will conduct multipurpose warhead design verification testing and warhead pre-qualification tests. In FY09, will design and initiate prototype development for small, low cost seeker/sensor system, and electronics for small lightweight precision munitions that meet urban and emerging threats.				
Close Combat Networking of Weapons and Sensors: In FY08, will complete technical specifications definition for network-enabled Tube-launched, Optically-tracked, Wire-guided (TOW), Improved Target Acquisition System (ITAS), and Javelin Command Launch Unit (CLU), including interfacing with the desired tactical network transport, infantry battle command, and display devices. Will conduct networked lethality trade studies, including consideration of interface to current and future infantry battle command. Will initiate mission software design and component-level assessment. In FY09, will continue mission software design and development. Will initiate prototype development and network integration of the Command Launch Unit Far Target Locators (FTLs) and a squad/platoon level infantry battle command interface. Initiate planning for a network lethality demo employing current and future tactical radios/waveforms.			3829	4709
Multi-Mission/Multi-Purpose Single Missile Propulsion: In FY08, will perform system level trades and initiate concept designs of gelled bi-propellants, pintle-controlled solids, and hybrids that provide longer ranges, close inner boundaries, and shorter flight times while increasing system insensitive munition capability and mission robustness in air-to-ground, ground-to-ground, and ground-to-air roles. In FY09, will complete concept designs. Will initiate fabrication and prepare for demonstration of critical components (including propellants, engine, expulsion systems, and controls) for variable propulsion motors. Will begin validation of designs.			1764	2270
Defense Against Rockets, Artillery, and Mortars (RAM): This project transitions from Defense Against RAM efforts in 0602303A project 214. In FY08, will begin development of integrated, form factored interceptor prototypes, launcher prototypes, and fire control prototypes capable of intercepting and defeating rocket, artillery, and mortar threats. Will begin fabrication of interceptor, launcher, and fire control components. In FY09, will complete fabrication of prototype interceptor, launcher, and fire control components and conduct bench and field testing. In addition, will integrate components and begin system level hardware in the loop testing and evaluation will use the results all component and system level testing to update and verify the system level simulations.			10785	19077
Small Business Innovative Research/Small Business Technology Transfer Programs		239		
Total	40159	9380	31119	37158

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**550**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
550 COUNTER ACTIVE PROTECTION	16294	12262	15395	15496	8278	5691	5816	5944

A. Mission Description and Budget Item Justification: This project matures and demonstrates integrated survivability technologies and techniques for lightweight combat platforms including light armored vehicles, tactical wheeled vehicles, and helicopters. Current aircraft survivability materiel solutions have limited effectiveness against optically aimed (i.e. "dumb") weapons such as Rocket Propelled Grenades (RPGs) and small arms. The Close-In Active Protection Systems (CIAPS) Phase 1 prototype has been demonstrated on a light armored vehicle. New sensor and interceptor technologies were matured in CIAPS Phase 2 to enable the system to be mounted on tactical wheeled vehicles for protection against RPGs. A new integrated aircraft survivability technology maturation program with mature new survivability techniques and technologies optimized to work in concert with components already matured and being fielded is being explored. System modeling and simulation conducted with user participation will maximize the opportunities for operator input to survivability system configuration and guide all aspects of technology maturation. Systems approach will ensure the avoidance of interference among survivability system components and techniques while taking every advantage of synergy and assistance from existing aircraft survivability components to improve the performance of the entire survivability suite. This project complements work done on adaptive infrared suppressor, Manned Unmanned Rotorcraft Enhanced Survivability (MURES), Survivability Planner Associate Re-router (SPAR) acoustic signature technologies matured in the Aviation Advanced Technology (program element (PE) 63003/313). This effort is building on the expertise developed in support of rockets, missile, sensors, and active control to develop innovative solutions survivability. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Close-In Active Protection Systems (CIAPS): The Close-In Active Protection Systems Phase 1 prototype (CIAPS 1) has been demonstrated on a light armored vehicle. New sensor and interceptor technologies have been matured in CIAPS Phase 2 (CIAPS 2) to enable the system to be mounted on tactical wheeled vehicles for protection against Rocket Propelled Grenades (RPGs) and reduce the size, weight, and power burden. This also decreases the hazard to dismounted troops operating with such a system. In FY06, completed the integration of CIAPS 2 radar and launcher, incorporating technologies matured under PE 0602303A Missile Technology, on HMMWV including dynamic testing against rocket-ball and RPG threats, proving accurate fire-control solutions. Completed dynamic testing of CIAPS 2 interceptors, including integration and operation of radio frequency data link, roll-control thruster firing system, confirming accurate interceptor flyout, and pointing. Proved all-composite interceptor limiting fragmentation to only the direction of the threat, minimizing the fragmentation hazard.	4800			
Kinetic Energy Active Protection System (KEAPS) Guided Interceptor: In FY06, developed and analyzed active protection system (APS) concepts using a guided interceptor for protection against tank gun fired threats as well as other long range threats to light armored platforms. Initiated component development for guided interceptor including guidance algorithms, inertial instruments, and control system. In FY07, continue development of guided interceptor component technologies to include guided interceptor guidance algorithms, inertial instruments, and control system. Build components and begin component and subsystem testing, including integration of tracking sensor/launcher ground station. Perform at least ten unguided flight tests. In FY08, will complete integration of interceptor components, conduct up to five pre-programmed flight tests, and demonstrate full guided interceptor in up to five flight tests. Will begin fabrication of	5744	11933	15395	15496

guided interceptors to support system level demonstration. In FY09, will complete fabrication of guided interceptors for system demonstration in 20 flight tests, support integration of AP system for demonstration, and support system level demonstration testing.				
Close-In Active Protection Systems (CIAPS) on Stryker: In FY06 this Congressional Add funded a risk reduction integration experiment under cooperative R&D agreement with the FCS AP developer using a prototype of the Quick-Kill close-in APS mounted on a Stryker vehicle.	5750			
Small Business Innovative Research/Small Business Technology Transfer Programs		329		
Total	16294	12262	15395	15496

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**704**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
704 Advanced Missile Demo	6589	2956	8373	6189	8000	10800	8500	6742

A. Mission Description and Budget Item Justification: This project demonstrates advanced state-of-the-art missile system concepts to enhance weapon system lethality, survivability, agility, versatility, deployability, and affordability for the Future Force. Current planned advanced demonstrations are Fire Control-Node Engagement Technology (FC-NET) and Advanced Multi-Role Miniature Precision Guided Missile (AMMPGM). The FC-NET program objective is to mature a common fire control architecture for combat vehicles. The resulting Fire Control Architecture will enable a platform to host, and a commander to effectively manage, an interchangeable, and distributed suite of weapons. The system will recommend Weapon-Target Pairings for multiple weapons (missiles and guns) and is expandable to include future weapon types. The objective of AMMPGM program is to mature and demonstrate advanced, miniature, multi-role precision-guided missile technology that provides robust defeat of a variety of non-armored threats from multiple platforms including manned and unmanned air and ground platforms with a significantly reduced logistics footprint. This program uses technology developed under 0602303A Missile Technology. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Fire Control Node Engagement Technology (FC-NET): In FY06, finalized technical fire control, validated the weapon target paring algorithms, and demonstrated the ability to give a common fire control for both missiles and guns in a live exercise.	3737			
Advanced Multi-Mission Precision Guided Munition (AMMPGM): In FY06, demonstrated an advanced insensitive munition (IM) and an improved lethality warhead, and a fuze subsystem compatible with the Hyrdra-70 and Advanced Precision Kill Weapon System II (APKWS II). This technology successfully transitioned to the APKWS II program. Also, demonstrated an improved insensitive munition rocket motor to improve minimum and maximum range system performance through static and ballistic flight testing. In FY07, design and begin fabrication of a prototype smart launcher and IM capability for the Hydra-70 family of munitions, as well as other munitions such as Joint Common Missile. In FY08, will complete fabrication and demonstration of the smart launcher through HWIL testing, bench testing, and live fire testing.	2486	2873	3373	
Counter Rockets, Artillery, Mortars (CRAM) Tracking, and Fire Control: In FY08, will transition short range surveillance sensors technology from PE 603004A and initiate fabrication of prototype short range surveillance sensors capable of acquiring and tracking rocket, artillery, and mortar threats under realistic operational conditions. Also, in FY08, will transition fire control sensor technologies from PE 0602303A (Missile technology) project 214 and initiate development and fabrication of prototype fire control sensors capable of providing end game accuracy for intercepting and defeating RAM threats. In FY09, will complete fabrication and test the prototype surveillance sensors in a relevant environment and integrate fire control sensor components for development and test.	366		5000	6189
Small Business Innovative Research/Small Business Technology Transfer Program		83		
Total	6589	2956	8373	6189

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**G03**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
G03	Army Hypersonics Advanced Technology			1985	1999	2044	2077	3121	2203

A. Mission Description and Budget Item Justification: This project funds advanced technology development to mature and validate, through evaluation testing, the critical technologies required to develop expendable hypersonic/hypervelocity missiles and interceptors to defeat hypersonic threats and Enhanced Area Air Defense Systems (EAADS) outer tier threats. Primary focus areas are those deemed critical for hypersonic/hypervelocity weapon maturation to enhance Army operational capability. These focus areas include engine component design, low cost seeker components, active and passive thermal management systems, material selection and evaluation, airframe structural analysis, and missile subcomponent design and development. Efforts include experimental model design and fabrication, instrumentation of experimental modes, extensive ground testing of matured component technology. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the US Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY08, transition technology from PE 0602303A project G02 to complete component technology designs; validate system design concepts and begin fabrication of components and subsystems. In FY09, will complete design and fabrication of missile components and subsystems, such as seekers, warheads, engine, guidance, or radomes, for ground testing at component level.			1985	1999
Total			1985	1999

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	26915	30218	25315	30935	32686	32920	33650	34384
608	COUNTERMINE & BAR DEV	19283	21815	22360	27576	27725	27860	28473	29099
64C	COUNTERMINE DEMONSTRATIONS (CA)	4984	4945						
683	Area Denial Sensors	2648	3458	2955	3359	4961	5060	5177	5285

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates sensor and neutralization technologies required to detect, identify, and then mitigate the effects of landmines, minefields,0 and obstacles. This work enables assured mobility for the high operational tempo (OPTEMPO) of the Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. This PE also conducts modeling and simulation activities to assess the effectiveness of system concepts. Project 608 focuses on concepts and technologies that will enable in-stride detection and breaching, close-in detection, area clearance, and neutralization of threats. This project demonstrates the ability to detect landmines and booby traps from handheld, ground, and aerial sensor systems; evaluates detection of both conventional and command detonated types of threats, metallic, and low/non-metallic threats; and emphasizes the use of wide-area multi-sensor fusion detection systems, coupled with small-area confirmation sensors. This multi-sensor approach has the potential to yield a high probability of threat detection with very low false alarm rates. Efforts within this project also assess available airborne sensors for use in landmine and booby trap detection missions for the current force. This project 608 also demonstrates novel explosive, electronic, and kinetic energy techniques to neutralize individual threats and to breach minefields. Project 683 explores alternative systems for anti-personnel landmines and innovative concepts for minefield clearance. Project 64C funds congressional special interest items.

Work in this PE is related to and fully coordinated with PE 0602712A (Countermine Systems), PE 0603710 (Night Vision Advanced Technology), and the US Marine Corps. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The PE contains no duplication with any effort within the Military Departments. Work in this PE is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	30092	25554	28512	32490
Current BES/President's Budget (FY 2008/2009)	26915	30218	25315	30935
Total Adjustments	-3177	4664	-3197	-1555
Congressional Program Reductions		-115		
Congressional Rescissions				
Congressional Increases		5000		
Reprogrammings	-3177	-221		
SBIR/STTR Transfer				
Adjustments to Budget Years			-3197	-1555

FY06 funds decreased to support higher priority efforts.
In FY08 funds decreased to support higher priority Army efforts.

Two FY07 congressional adds totaling $4792 (after adjustment for Congressional undistributed reductions) were added to this PE.

($958) EDIT Advanced Landmine Detection
($3834) Advanced Demining Technology

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**	**608**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
608 COUNTERMINE & BAR DEV	19283	21815	22360	27576	27725	27860	28473	29099

A. Mission Description and Budget Item Justification: This project matures and demonstrates countermine technologies for integration into future Army systems, and where feasible, exploit opportunities to enhance Current Force capabilities. The projects goal is to mature and demonstrate robust approaches to finding surface-laid and buried threats in temporally and spatially varying vegetation, soil, weather, and diurnal conditions. This effort focuses on enabling assured mobility for the Future Force. Specific activities include remote detection of minefields by aerial sensor systems, detection of individual threats by handheld and vehicle-based sensor systems, and neutralization of individual booby traps, landmines, and minefields. The threats being addressed include conventional, command detonated, and metallic and low/non-metallic anti-tank and anti-personnel threats. This project evaluates the effectiveness of wide-area multi-sensor fusion detection systems, coupled with slower small-area confirmation sensors, to yield a high probability of detection (Pd) at very low false alarm rates (FAR). This project evaluates airborne multispectral threat detection sensors and matures them for lightweight plug-and-play use on unmanned aerial vehicles (UAVs) in mission specific applications. Efforts are supported by modeling and simulation assessments to define potential system effectiveness. Efforts in standoff mine detection provide mine detection capabilities for faster rate of advance (ROA) in high threat areas, using teamed sensors on both ground vehicles (at greater distances from the threat), and UAVs. Autonomous mine detection sensor efforts provide the ability to detect anti-personnel mines at faster rates of advance (ROA), by integrating mine detection sensors onto robotic platforms which preceeds the Soldier thereby keeping the Soldier away from danger. Ground penetrating radar research efforts provide faster ROA for on-route and off-route mine detection capability with high probability of detection (Pd) and low false alarm rate (FAR). Airborne threat detection efforts demonstrate automated processes and algorithms that improve upon the current change detection process used to detects landmines and booby traps. The Standoff Detection and Neutralization for Convoy Escort and Route Clearance effort demonstrates vehicle mounted technologies for in-stride detection and neutralization of roadside and in-road threats. The Mine Detection Payload for UAVs effort demonstrates an airborne sensor payload and a threat detection algorithm suite.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Minefield neutralization efforts are closely coordinated with Navy/USMC. Work in this PE is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Ft. Belvoir, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Standoff Mine Detection System: In FY06, completed integration and fusion of forward looking sensors on a single platform; demonstrated and analyzed system effectiveness of integrated ground vehicle sensor package and Aided Target Recognition (AiTR). In FY07, demonstrate and integrated forward looking sensor suite coupled with a ground penetrating radar then evaluate performance of vehicle mounted forward looking cueing sensors in relevant environment.	4801	4943		
Autonomous Mine Detection Sensors (AMDS): In FY06, refined ground penetrating radar (for detection of anti-personnel mines) design based on initial studies and increased performance of Automated Target Recognition (ATR) algorithms in off-road conditions; conducted blind test with improved sensor and ATR algorithms. In FY07, complete final prototype sensor build and ATR/signal processing implementation on surrogate platform; conduct field tests in relevant environments. Prepare for transition to PM-CCS.	4766	2806		

Ground Penetrating Radar (GPR) Countermine On The Move: In FY06, refined GPR hardware and Automated Target Recognition (ATR); continued on and off route mobility demonstrations and evaluation. In FY07, complete ATR development and GPR integration onto a UGV; conduct a series of on and off route demonstrations in a variety of operational scenarios and under representative environmental conditions; complete mobility evaluation. Transition to PM-CCS.	4246	4808		
Standoff Threat Detection and Neutralization for Convoy Escort and Route Clearance: In FY08, will mature vehicle mounted technologies and prototypes that provide standoff detection and neutralization of roadside and in-road threats to enable uninterrupted mobility and increase survivability for both convoy escort and route clearance mission. Detection sensors and sensor combinations may include conventional and non-linear radar, electromagnetic induction, and passive magnetometry, electro-optics, lasers, and chemical detection sensors. Neutralization techniques include directed energy and conventional ballistic approaches. In FY09, will continue development of detection and neutralization components; will conduct a series of component testing and select the most promising technologies/components for convoy escort and route clearance prototypes; will mature and demonstrate sensor fusion algorithms to reduce false alarm rates in high clutter/urban environments; will investigate directed energy and conventional ballistic approaches tailored to the full spectrum of the threats.			15247	19397
Airborne Mine Detection: In FY06, continued algorithm and automation (software that compares consecutive frames of imagery in order to detect changes) developments; integrated cueing algorithms into the Change Detection Work Station (CDWS); integrated sensors (IR and visible) for an improved threat detection capability; conducted flight test and data analysis. In FY07, upgrade data collection assets to reduce the processing burden and automate, via software, the change detection activities between consecutive frames from the high altitude payload; complete cueing algorithm development and sensor integration; conduct system flight demonstrations in military like environment and assess performance of the system.	5470	5324		
Mine and Minefield Detection Payload for Tactical Unmanned Aerial Vehicle (TUAV): In FY07, conduct trade studies and modeling of sensor candidates to meet size, weight, and power constraints of a medium altitude TUAV airborne payload; initiate sensor and algorithm development tailored to sensor selection and mission. In FY08, will complete sensor development and integration, perform flight testing/data collections on manned aircraft and mature algorithms through sensor data collections and analysis. In FY09, will finalize algorithm development and demonstrate system performance to achieve exit criteria in temperate and arid environments.		3484	7113	8179
Small Business Innovative Research/Small Business Technology Transfer Programs		450		
Total	19283	21815	22360	27576

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**	**683**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
683 Area Denial Sensors	2648	3458	2955	3359	4961	5060	5177	5285

A. Mission Description and Budget Item Justification: This project provides demonstrations of surveillance, command, and control technology components for alternative systems that minimize the risk of injury or loss to non-combatants from exposure to anti-personnel landmines (APLs). The technology components include distributed personnel surveillance systems (autonomous seismic, acoustic, and day/night imaging sensor systems), and command and control systems (ad hoc networked, wireless, sensor communications, and information management tools) to be used with man-in-the-loop overwatch fires. This project uses simulation to evaluate new concepts and modify doctrine. This project also constructs components, as well as, system architectures and conducts evaluations at the system level in field tests.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The PE contains no duplication with any effort within the Military Departments. Work in this PE is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Area Denial Sensors: In FY06, completed standoff detection study, completed testbed and demonstrated initial personnel detection and discrimination capability. In FY07, mature ground sensor discrimination algorithms; demonstrate an unattended ground sensor working with an intelligent mine system concept of operations for discriminating combatant from noncombatant. In FY08, will continue maturation of discrimination algorithms; will incorporate advanced personnel detection sensors into testbed UGS; will demonstrate modeling and simulation of sensor and operator interface. In FY09, will demonstrate detection and combatant/noncombatant discrimination with testbed unattended ground sensor (UGS); will begin development of next generation sensor and discrimination system.	2648	3361	2955	3359
Small Business Innovative Research/Small Business Technology Transfer Programs		97		
Total	2648	3458	2955	3359

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603607A - JOINT SERVICE SMALL ARMS PROGRAM**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	7971	8112	8097	8856	9136	9394	8711	8632
627	JT SVC SA PROG (JSSAP)	7012	7123	8097	8856	9136	9394	8711	8632
62D	SMALL ARMS ADVANCED TECHNOLOGY DEV (CA)	959	989						

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates advanced technologies that integrate into individual and crew served weapons for all Services to provide greater lethality, utility, and range at a significantly reduced weight for the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The main effort is the Lightweight Small Arms Technologies (LSAT). The LSAT will offer significantly reduced weight over the currently fielded weapons and ammunition. These technologies will lighten the Soldier's load, provide improved battlefield mobility, and reduced logistics burden to maximize operational utility and survivability, while maintaining or improving current levels of performance. All Joint Service Small Arms Program (JSSAP) efforts follow the Joint Service Small Arms Master Plan (JSSAMP), the Joint Capabilities Integration Development System (JCIDS) Small Arms Analysis, and the resulting Capabilities Development Documents. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP) and the Defense Technology Area Plan (DTAP). Work is performed by the US Army Armament Research, Development, and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is related to and fully integrated with the efforts funded in PE 0602623A (Joint Service Small Arms Program) and PE 0602624A (Weapons and Munitions Technology). Transition paths have been established in coordination with Program Executive Officer (PEO) Soldier, Project Manager Soldier Weapons, Product Manager (PM) Crew Served Weapons, PM Individual Weapons, United States Marine Corps (USMC) PM Infantry Weapons; and PEO Special Programs, US Special Operations Command (SOCOM). Project 627 contains congressional adds only.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603607A - JOINT SERVICE SMALL ARMS PROGRAM**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	7474	7202	7360	7472
Current BES/President's Budget (FY 2008/2009)	7971	8112	8097	8856
Total Adjustments	497	910	737	1384
Congressional Program Reductions		-31		
Congressional Rescissions				
Congressional Increases		1000		
Reprogrammings	497	-59		
SBIR/STTR Transfer				
Adjustments to Budget Years			737	1384

FY08 and FY09 funds increased to support development of smaller, lighter weight, small arms (weapons and rounds) with increased target acquisition/tracking capability.

One FY07 congressional add totaling $958 (after adjustment for Congressional undistributed reductions) was added to this PE.

($958) Lightweight Small Arms Technologies (LSAT)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603607A - JOINT SERVICE SMALL ARMS PROGRAM**	**627**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
627 JT SVC SA PROG (JSSAP)	7012	7123	8097	8856	9136	9394	8711	8632

A. Mission Description and Budget Item Justification: This project matures and demonstrates advanced technologies that integrate into individual and crew-served weapons for all Services to provide greater lethality, utility, and range at a significantly reduced weight for Future Combat Systems (FCS), the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The main effort is the Lightweight Small Arms Technologies (LSAT). The LSAT will offer significantly reduced weight over the currently fielded weapons and ammunition. These technologies will lighten the Soldier's load, provide improved battlefield mobility, and reduced logistics burden to maximize operational utility and survivability, while maintaining or improving current levels of performance. All Joint Service Small Arms Program (JSSAP) efforts follow the Joint Service Small Arms Master Plan (JSSAMP), the Joint Capabilities Integration Development System (JCIDS) Small Arms Analysis, and the resulting Capabilities Development Documents. The cited work is consistent with the Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), and the Defense Technology Area Plan (DTAP). Work is performed by the US Army Armament Research, Development, and Engineering Center, Picatinny Arsenal, NJ. Work in this PE is related to and fully integrated with the efforts funded in PE 0602623A (Joint Service Small Arms Program) and PE 0602624A (Weapons and Munitions Technology). Transition paths have been established in coordination with Program Executive Officer (PEO) Soldier, Project Manager Soldier Weapons, Product Manager (PM) Crew Served Weapons, PM Individual Weapons, United States Marine Corps (USMC) PM Infantry Weapons; and PEO Special Programs, US Special Operations Command (SOCOM).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Lightweight Small Arms Technologies (LSAT): In FY06, built integrated weapon prototypes to test weapon and ammunition functionality and human factors and validate/update virtual prototypes; modified weapon system to incorporate improvements, matured weapon system to increase reliability; modified ammunition case configuration, case material, and bullet retention, and attained required muzzle velocity, interior ballistics, chamber pressure, and port pressure; assessed maintenance and training issues and made necessary modifications to Soldier interfaces, assembly, and disassembly procedures, and loading of ammunition. In FY07, perform integration testing to demonstrate lethality and reliability of the lightweight weapons and ammunition in a light machine gun configuration, identify, and fabricate prototype alternate weapon configurations and perform trade studies to determine best application(s) for lightweight technologies, continue refinement of ammunition, and weapon designs to achieve maxiumum weight reduction with best lethality and reliability characteristics.	6336	6951		
Lightweight Small Arms Technologies Demonstrations: In FY08, will mature and demonstrate high payoff technologies from LSAT that are technically successful, affordable, and manufacturable. Identify and complete development of desired ammunition and weapon configuration, fabricate quantities of ammunition and weapons, and test hardware to validate analyses. In FY09, will fabricate all necessary ammunition and weapons to complete the test program in accordance with International Test Operating Procedures (ITOPs) to achieve required maturity level for weapon/ammunition system, perform safety and environmental testing, and conclude with user testing.			7360	7472
Small Arms Enabling Technolgy Demonstrations: In FY08, will begin system integration planning and modeling as part of system engineering for existing and potential future weapon concepts. In FY09, will begin to develop laser ranging electronics for weapon integration base on feasibility established in complimentary program in PE 0622623A/project H21.			737	1384
Air-bursting Munition: In FY06, continued engineering improvements to air-bursting munition fragmenting body and demonstrated a	676			

protoytpe concept.				
Small Business Innovative Research/Small Business Technology Transfer Programs		172		
Total	7012	7123	8097	8856

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603710A - NIGHT VISION ADVANCED TECHNOLOGY**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	91213	75615	35892	40114	40800	44209	45872	46958
590	OVERWATCH ACTD	1194	296						
C65	DC65	5918	4509	397					
K70	NIGHT VISION ADV TECH	14098	17588	23003	23664	26993	28480	28775	29485
K73	NIGHT VISION SENSOR DEMONSTRATIONS (CA)	49264	31796						
K86	NIGHT VISION, ABN SYS	20739	21426	12492	16450	13807	15729	17097	17473

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates sensor technology that will provide the Army with the capability for reconnaissance, surveillance, and target acquisition beyond today's tactical lines-of-sight and enhance the Army's ability to operate in all battlefield conditions. Major efforts within this PE are designed to increase survivability and lethality by providing sensor capabilities to acquire and engage targets at longer ranges in complex environments and conditions (e.g. day/night, obscured, smoke, adverse weather) in support of the Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. Project 590 focuses on assessing the military utility and maturing concepts of operation to address counter ambush operations. Project C65 funds classified efforts. Project K70 funds efforts related to night vision advanced technologies. This project will: develop technologies for networked, low-cost, distributed unmanned sensors for battlefield situational awareness, cost effective targeting (CET), and for autonomous target acquisition; demonstrate situational awareness for infantry carriers operating in close-in complex terrain; provide the vehicle commander, crew members, and dismounting infantry with an independent, simultaneous, multi-user close-hatched 360°x90° hemispherical view of the area surrounding a stationary or moving vehicle during day and night operations; demonstrate mission equipment packages (MEP) for unmanned air vehicles (UAVs) that enable small, lightweight, interchangeable payloads of varying sizes to support target detection, identification, and location; demonstrate the combat overmatch benefits of third Generation Infrared (IR) technology, including benefits such as rapid wide area search, multispectral aided target detection (AiTD), difficult target detection, and passive long range target identification (ID beyond threat detection) in both an air prototype and ground test-bed while on-the-move (OTM), and will support efforts to use standard components across multiple applications for cost savings; demonstrate the technical maturity of single-color, long wave infrared (LWIR), ground based Aided Target Recognition (AiTR) algorithms and Long Range Laser Target Identification (LRTID) utilizing gated Short Wave Infrared (SWIR) components; and insert third Generation IR assembly into a ground based long range sensor suite; demonstrate components to improve Soldier situational awareness. Project K86 funds efforts related to airborne night vision systems. This project demonstrates sensors and algorithms designed to detect targets (vehicles, personnel, mines) in camouflage, concealment, and deception; demonstrate sensors for UAV for beyond-line-of-sight targeting in areas shadowed by terrain features; demonstrate imaging, non-imaging, and active imaging sensors for UAV platforms; evaluate and demonstrate improved survivability and lethality by providing ID at enemy's detection ranges; and provide pilotage and situational awareness imagery to multiple pilots/crew members independently for enhanced crew/aircraft operations in day/night/adverse weather conditions. Project K73 funds congressional special interest items.

Work in this PE is related to and fully coordinated with efforts in PE 0602709A (Night Vision and Electro-Optics Technology), PE 0602270A (Electronic Warfare Technology), PE 0603774A (Night Vision Systems Advanced Development), and PE 0604710A (Night Vision Systems Engineering Development). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). This PE adheres

to Tri-Service Reliance agreements on sensors and electronic devices, with oversight, and coordination provided by the Joint Directors of Laboratories. Work in this PE is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA and the Army Space and Missile Defense Command, Huntsville, AL (the Overwatch ACTD).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603710A - NIGHT VISION ADVANCED TECHNOLOGY**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	101690	44307	35808	41685
Current BES/President's Budget (FY 2008/2009)	91213	75615	35892	40114
Total Adjustments	-10477	31308	84	-1571
Congressional Program Reductions		-289		
Congressional Rescissions				
Congressional Increases		32150		
Reprogrammings	-10477	-553		
SBIR/STTR Transfer				
Adjustments to Budget Years			84	-1571

FY06 funds decreased to support higher priority efforts.

Twelve FY07 congressional adds totaling $30815 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1533) Advanced Passive Millimeter Wave Imager
($4074) Buster Backpack Unmanned Aerial Vehicle
($6709) Camera Asisted Monitoring System (CAMS)
($1725) Cerberus Sensor Suite Program - K70
($1294) Cost Effective Targeting Sys Demo/Integ into Stryk
($3738) Enhanced Digital Electronic Night-Vision for UGVs
($2492) Real-Time Geospatial Video Sensor Intel-NVESD
($1390) Additive NV Capabilties for Deployed Systems
($1534) Collimated IR Weapon Sniper Sight/Spotter Scope
($3834) EO Sensor Technology for Suicide Bomber Detection
($1246) Electron Bombarded Active Pixel Sensor Camera
($1246) Ubiquitously Persistent Surveill for Force Protect

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603710A - NIGHT VISION ADVANCED TECHNOLOGY**	**K70**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
K70 NIGHT VISION ADV TECH	14098	17588	23003	23664	26993	28480	28775	29485

A. Mission Description and Budget Item Justification: This project matures and demonstrates high-performance integrated sensor/multi-sensor technologies to increase target detection range, extend target identification range, and reduce target acquisition (TA) timelines for dismounted Soldiers and tactical vehicles against threats that are beyond today's ranges or are partially obscured by terrain features. This capability, linked to the limited situational awareness from the overhead/strategic available assets, is critical to the survivability, utility, and maneuver planning of the Army's Future Force, and where feasible, exploits opportunities to enhance Current Force capabilities. The maturation of distributed aperture sensors provides situational awareness imagery and target identification independently to the commander or multiple crew members for enhanced operations in day/night/adverse weather conditions. Third generation infrared (third Generation IR) technology efforts provide a combat overmatch capability for ground scouts and line of sight (LOS) shooters, ensuring passive, long range target detection, and identification (ID beyond threat detection) on ground platforms, through: collection of multispectral IR data sets for future Aided Target Detection (AiTD)/Aided Target Recognition (AiTR) algorithm development and third Generation IR performance model development; development of a single 640x480 third Generation integrated Dewar/Cooler specification for air and ground platforms The third Generation IR technology effort also includes the maturation of multispectral AiTR algorithms and advanced Digital Signal Processing (DSP) algorithms to take advantage of third Generation IR imagers for insertion into medium range electro-optical system. The Soldier mobility vision system matures a low power prototype system with full field-of-view (40 degree minimum) digitally-fused uncooled long wave IR and image intensified (I2) visible/near IR helmet mounted vision system for mobility, target detection, and situational awareness in complex terrain. It includes the ability to import alternate imagery/data (e.g. from a weapon sight) to the high resolution Helmet Mounted Display (HMD) and to export Soldier borne sensor imagery and directly supports the PEO Soldier Digital Enhanced Night Vision Goggle (DENVG) program. The Miniature Target Acquisition, Far Target Locator System effort provides the dismounted Soldier with a miniature light weight, low power hand held, far-target locator system. The far target locator includes real-time adaptive Visible Near Infrared/Short Wave Infrared/Long Wave Infrared (VNIR/SWIR/LWIR) sensor fusion, a laser rangefinder/marker/illuminator, embedded global positioning system, target position determination, image and video transmission/reception/display, and electronic zoom with super-resolution (e.g. a method of increasing resolution by exploiting scanning anomalies like jitter/motion) capabilities.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Third Generation IR Technology: In FY06, completed integration of third Generation Long Range Advanced Scout Sensor System (LRAS3) prototype sensor and conducted lab and field testing and evaluation; completed vehicle integration of third Generation LRAS3 and conducted initial data collection of Dual Band imagery for multi-spectral (MS) AiTR development and training utilizing third Generation prototype sensor; began initial definition and system modeling for the insertion of MS AiTR coupled with 2-color AiTD processor development; completed fabrication of control station and integration of dual band focal plane array (FPA) and dewar into the surrogate AN/ZSQ-2 Aviation Turret; completed integration of dual band surrogate Aviation Turret into rotary wing aircraft. In FY07,	5840	12528	9456	

complete dual band, phenomenology study data collections with the third Generation prototype LRAS3; complete design and fabrication of mini-LRAS3 brass-board optics; begin integration and demonstration of slim-line dual band FPA Dual F# dewar and miniaturized electronics (i.e. Slim-line, prototype, third Generation sensor) into medium range electro optic (MREO) turret sensor and mini-LRAS3 brass-board demonstrator. In FY08, will finalize common air and ground integrated detector/cooler assembly specifications and complete the integration of the dual band focal plane array (FPA), dual F# dewar and miniaturized electronics into the medium range electro optics system; will conduct multi-spectral aided target recognition evaluation with dual band FPA, dual F# dewar.				
Soldier Mobility Vision System: In FY06, conducted trade studies to determine system components and preliminary system design definition with functionality, algorithms, and interface requirements analysis; conducted human factors experimentation using NVESD-fabricated head-mounted testbeds with Army Research Laboratory Human Research and Engineering Directorate in support of initial system design and functionality. In FY07, finalize system design; conduct critical design review of the system and Application Specific Integrated Circuit (ASIC) for a low power, full field-of-view, digitally fused prototype helmet mounted vision system. In FY08, will complete ASIC fabrication and deliver working ASIC to the PEO Soldier digital enhanced night vision goggle (DENVG) program; will begin system hardware maturation and integration. In FY09, will complete the integration of prototypes; will conduct technical testing and user evaluation and transition products to the DENVG program.	1890	1787	4720	3473
Target Acquisition Sensor Suite (TASS) Technology Maturity Demonstrator: In FY06, conducted field test and demonstrated performance of aided target recognition (AiTR) algorithms at three test sites Ft. Hunter-Liggett, Ft. McCoy, and Yuma Proving Grounds; demonstrated long range laser target identification capability of high powered laser-gated short wave infrared.	3534			
Distributed Aperture System (DAS): In FY06, incorporated lessons learned from DAS-1 prototype testing and integrated color TV, infrared (IR), and image intensification (I2) sensors into DAS-2 design; matured pixel level fusion enabling infrared/image intensification (IR/I2) or IR/color TV imager to be separately accessible for each crewmember; devised and evaluated initial software modifications for automatic cueing of pop-up/moving personnel targets. In FY07, complete DAS-2 design; integrate DAS-2 onto troop carrying demonstrator vehicle; conduct DAS-2 user experimentation in complex and urban terrain; transition to PM-NV/RSTA.	2834	2895		
Dismounted Troop Carrier Closed Hatch Local Situational Awareness: This effort will leverage existing DAS architecture and demonstration hardware to develop and integrate the automated pop up target detection algorithms and a 360 x 90 digital video recording capability with gunfire detection and audible sensing onto a vehicle platform. Target information will be transmitted onto the tactical network for force situational awareness and possible multiple target engagements. In FY08, will develop user approved vignettes to define requirements, will define sensor capabilities and product transitions. In FY09, will conduct trade off analyses of sensor and system design approaches; will define system architecture and planned interfaces; will complete modeling and simulation of human factors and operator cognitive loading of information; will initiate hardware development efforts to provide improved situational awareness, reconnaissance, surveillance, and actionable targeting information for the vehicle commander and crew in the urban fight.			327	3861
Miniature Target Acquisition, Far Target Locator System: In FY08, will leverage the DARPA Multispectral Adaptive Networked Tactical Imaging System (MANTIS) Phase III program technologies of short wave infrared (SWIR), sensor fusion, and power management, and begin to integrate those technologies into the next generation of the PEO Soldier MRK VIIE program (formerly TALON II program), a handheld multispectral (TV, NIR, LWIR) target locator that uses a digital magnetic compass and GPS to pinpoint and relay target coordinates; will demonstrate day/night SWIR and additional laser capabilities with the MRK VIIE. In FY09, will conduct a series of field tests/data collections to demonstrate the required SWIR and laser phenomenology necessary for target detection capability of those hard to find targets; will develop an interface with existing/developmental dismounted Soldier communication systems for real time video/image transmission.			3000	3481

Dismounted Soldier Networked Situational Awareness with Sensor Imagery: Based on previous development of Soldier vision sensors, this effort will demonstrate the ability to display networked Situational Awareness (SA) information simultaneously with sensor imagery, through a Soldier display for weapon or head mounted sensors, provided via an established Soldier communications architecture. In FY09, will define system architecture and planned interfaces; will complete modeling and simulation of system base performance along with human factors and operator cognitive loading of SA information; will initiate hardware development efforts to provide improved SA, reconnaissance, and surveillance information which leverage recent component technology developments, in traditional and unused portions of the EO spectrum, to provide actionable targeting information for the dismounted Soldier in the urban fight.				4111
Advanced Lightweight Reconnaissance and Designation Sensor (ALWRDS): This effort leverages the significant investment by the industrial base in small pixel, mid-wave infrared (MWIR) focal plane arrays (FPAs), and the US Army applied research investment in extremely lightweight, low power laser designation technology from the Ultra-Lightweight Laser Designation effort to provide the individual dismounted Soldier and vehicle crews with an advanced lightweight target detection and call for fire capability. In FY08, will complete performance modeling and trade off analyses of a modular, ultra lightweight, man portable, low power, multi-sensor system for individual dismounted Soldiers and vehicular missions that utilizes small pixel, MWIR thermal sensor technology, far target location capability, and clip-on laser designator; will begin the fabrication of the small pixel, MWIR thermal imaging sensor. In FY09, will mature the ALWRDS sensor suite; will continue the fabrication of the small pixel, MWIR thermal sensor; will begin the fabrication of the lightweight, clip-on laser designator and far target location capability; and will conduct initial field performance evaluation of the small pixel, MWIR thermal sensor.			5500	6376
Unmanned Sensors for Urban Missions (USUM): This effort will leverage manportable robotic platform sensor development and urban unattended ground sensors efforts conducted under the Cave and Urban Assault ACTD to develop and integrate multiple sensor modalities, i.e. imaging, acoustic, explosive detection, on board a single manportable robotic platform to provide a flexible multi-mission capability and to provide enhanced low cost imager for urban UGS application. In FY09, will complete trade off analyses of sensor and system design approaches; will define system architecture and planned interfaces; will complete modeling and simulation of human factors and operator cognitive loading of information; will initiate hardware development efforts to provide improved situational awareness, reconnaissance, surveillance, and actionable detection/situational awareness information for the Soldier.				2362
Small Business Innovative Research/Small Business Technology Transfer Programs		378		
Total	14098	17588	23003	23664

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603710A - NIGHT VISION ADVANCED TECHNOLOGY**	**K86**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
K86 NIGHT VISION, ABN SYS	20739	21426	12492	16450	13807	15729	17097	17473

A. Mission Description and Budget Item Justification: This project matures and demonstrates intelligence, surveillance, reconnaissance, targeting, and pilotage technologies in support of the Army's aviation and networked systems. The goal is to provide the capability to detect and identify partially obscured targets from manned and unmanned air platforms and to perform reconnaissance, surveillance, and target acquisition (RSTA) and target designation beyond today's tactical line-of-sight. This capability is critical to the survivability of the brigade combat team (BCT) and future light maneuver forces. The technology efforts focus on improved RSTA and night pilotage sensors, high-resolution heads-up displays, sensor fusion, and aided target recognition (AiTR) capabilities for current and future helicopters (attack, scout, cargo, and utility) and unmanned aerial vehicles (UAVs). UAV payload efforts mature and demonstrate small, lightweight, modular, payloads (electro-optical/infrared, laser radar, designator) to support target detection, identification, location, tracking, and targeting of tactical targets for the BCT. The third Generation Infrared Technology effort for aviation improves survivability and lethality by providing identification at enemy's detection ranges and standardized components across different applications for cost savings. Next generation pilotage efforts demonstrate an advanced, cost effective, light weight sensor system which provides simultaneous multi-pilot/user, view of immediate surroundings available to the entire crew for enhanced pilotage in degraded and brown out conditions, and constant wide field of regard coverage for visual alert to potential attack while on-the-move or in hover for Utility and Heavy Lift rotorcraft. Advanced Active Payloads demonstrates improved target ID and laser designation capabilities from small platforms such as Class I UAVs; investigates and matures other promising active payload concepts based on lightweight multi-purpose laser components to provide obstacle avoidance, local area terrain/feature mapping and/or through foliage/camouflage sensing. Tactical Airborne Spectral Reconnaissance will develop and demonstrate passive spectral imaging payloads for tactical applications such as detection/identification of difficult targets, countermine detection, and battle damage assessment.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command/Communications-Electronics Research, Development, and Engineering Center/Night Vision and Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Unmanned Aerial Vehicle (UAV) Electro-Optic (EO) Payloads: In FY06, maturated imaging and stabilization components for an active imaging foliage penetration (FOPEN) sensor; performed laboratory measurements and experiments of multiple active imaging FOPEN technologies; completed non-imaging FOPEN studies and evaluated approaches; completed the design and began fabrication of the reconnaissance, surveillance, and target acquisition (RSTA)/laser designation (LD) payload. In FY07, complete maturation and integration of reconnaissance, surveillance, and target acquisition (RSTA)/LD payload and conduct flight experiments from manned platform; begin integration of RSTA/LD payload onto UAV platform; conduct a series of field experiments and data collections of multiple FOPEN technologies; and demonstrate recommended active imaging FOPEN technologies system concepts and non-imaging FOPEN system concepts for small UAVs.	10413	11377		
Third Generation Infrared (IR) Technology: In FY06, completed modification of the aviation prototype third Generation IR sensor, with dual band focal plane arrays (FPAs) for long range target identification test and experimentation; completed Airborne third Generation IR	10326	7536	4589	

sensor control station fabrication; completed procurement and modification of surrogate AN/ZSQ-2 aviation turret with 640x480 dual band IR FPA; performed laboratory and ground system evaluation of the surrogate AN/ZSQ-2 aviation turret with 640x480 dual band IR FPA installed; modified Blackhawk testbed to accept the surrogate AN/ZSQ-2 aviation turret and completed integration of the surrogate AN/ZSQ-2 aviation turret; continued maturation of the third Generation integrated detector cooler assembly specifications. In FY07, conduct flight test of third generation infrared technology integrated into the surrogate AN/ZSQ-2 aviation turret and onto the Blackhawk testbed; analyze results of flight test to demonstrate the enhanced target detection, and identification offered with a two-color target acquisition system. In FY08, will complete demonstration of wide area search algorithms and integrate into the airborne control station; will perform flight tests of the surrogate AN/ZSQ-2 aviation turrets wide area search capability; will record third Generation imagery to support dual color Aided Target Recognition (AiTR) maturation; and will complete the fabrication and testing of the dual color, dual f# slim-line imagers optics.				
Objective Pilotage for Utility and Lift: In FY07, conduct sensor trade studies to determine the best low cost combination of distributed aperture pilotage sensors for lift and utility helicopters; select an affordable combination of Long Wave Infrared (LWIR), Medium Ware Infrared (MWIR), Near Infrared (NIR), Image Intensified (I2), Low Light Level TV, Short Wave Infrared (SWIR) sensors; conduct assessment of processor requirements to provide sensor suite interface and image stitching, image fusion and threat warning techniques. In FY08, will down-select sensors configurations, refine requirements and design specifications, assess and select available displays (helmet mounted display, panel mounted display); will mature design and build sensor suite (including sensor pods, processors, displays, and required interface equipment). In FY09, will integrate sensor suite onto a helicopter testbed; conduct flight evaluation to perform engineering checkout, assess integration and sensor suite performance, and study human factors aspect of multi-sensor, multi-spectral, eye points, and their impact on mission performance; conduct limited user flight assessment.		1990	4903	7250
Active Imaging for Unmanned Aerial Systems: In FY08, will conduct design studies to investigate promising compact payload concepts, finalize payload performance goals, and establish laser component requirements; initiate development of 5 lb payload compatible with the Class 1 UAVs with reconnaissance, surveillance, target acquisition (RSTA), and laser designation (LD) capabilities. In FY09, will demonstrate proof-of-principle RSTA and LD payload breadboard; finalize RSTA and LD payload system design; conduct initial demonstrations of the laser, detector, and pointing/stabilization subsystems.			3000	5200
Tactical Airborne Spectral Reconnaissance: In FY09, will demonstrate passive spectral imaging payloads for tactical applications such as detection and identification of difficult targets, countermine detection and battle damage assessment; will evaluate passive spectral imaging sensors against active doppler vibrometer systems.				4000
Small Business Innovative Research/Small Business Technology Transfer Programs		523		
Total	20739	21426	12492	16450

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	15306	17098	14982	16449	16666	16838	17208	17587
002	ENVIRONMENTAL COMPLIANCE TECHNOLOGY	1272	1967	2026	2068	2091	2106	2152	2200
025	POLLUTION PREVENTION TECHNOLOGY	2979	3433	3532	3645	3725	3799	3883	3968
03E	ENVIRONMENTAL RESTORATION TECHNOLOGY	7797	8533	9424	10736	10850	10933	11173	11419
03F	Environmental Quality Tech Demonstrations (CA)	3258	3165						

A. Mission Description and Budget Item Justification: The objective of this advanced technology development program element is to mature and demonstrate technologies that assist Army installations in becoming environmentally compatible without compromising the readiness or training critical to the success of the Future Force. Technologies demonstrated within this program element are transitioned from PE 0602720A (Environmental Quality Technology). This program includes technology demonstrations for: restoration of sites contaminated with toxic and/or hazardous materials (such as unexploded ordnance [UXO]) resulting from Army operations; pollution prevention to minimize the Army's use and generation of toxic chemicals and hazardous wastes; compliance with environmental laws by control, treatment, and disposal of hazardous waste products; and conservation of natural and cultural resources while providing a realistic environment for mission activities. This program demonstrates technological feasibility, assesses the technology and its producibility, and transitions mature technologies from the laboratory to installations. Technologies developed by this program element improve the Army's ability to achieve environmental restoration and compliance at its installations, at active and inactive ranges and other training lands, and at its rework and production facilities. Technologies demonstrated focus on reducing the cost of treating hazardous effluents and remediating Army sites contaminated by hazardous/toxic materiel. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, and the US Army Research, Development, and Engineering Command, headquartered at Fort Belvoir, VA, execute the project work.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	15777	14089	15098	16479
Current BES/President's Budget (FY 2008/2009)	15306	17098	14982	16449
Total Adjustments	-471	3009	-116	-30
Congressional Program Reductions		-65		
Congressional Rescissions				
Congressional Increases		3200		
Reprogrammings	-471	-126		
SBIR/STTR Transfer				
Adjustments to Budget Years			-116	-30

One FY07 congressional adds totaling $3066 after adjustment for Congressional undistributed reductions was added to this PE.

($3066) Alternate Power Fuell Cell Demo at FT. Irwin

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**	**002**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
002	ENVIRONMENTAL COMPLIANCE TECHNOLOGY	1272	1967	2026	2068	2091	2106	2152	2200

A. Mission Description and Budget Item Justification: The objective of this advanced technology development project is to mature and demonstrate technologies transitioned from program element (PE) 0602720A (Environmental Quality Technology), projects 048 and 896 that assist Army installations in achieving environmental compliance. These technologies reduce the cost of treating hazardous effluents from Army installations, including ammunition plants, depots and arsenals, to satisfy increasingly stringent wastewater and air pollutant discharge standards. Army facilities are now subject to fines and facility shutdowns for violation of federal, state, and local air and wastewater discharge regulations. This technology is essential to control and reduce the generation of waste to satisfy hazardous waste reduction goals, and to avoid future hazardous waste disposal costs and liabilities to the Army. Efforts under this project enable the Army to reduce pollution at installations while complying with the myriad of federal, state, and host country regulations dealing with hazardous wastewater, air emissions, and solid wastes. Technologies demonstrated also reduce the cost of resolving training noise compliance issues for the Army, avoid reductions in availability of training facilities, and sustain the viability of testing and training ranges. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Installation Operations: Demonstrate environmentally safe and cost-effective technologies for removing lead-based paint and reducing Hazardous Air Pollutants (HAP) emissions from Army sources to meet National Emission Standards for HAP that will continue under project 025 and to manage and reduce the increase in noise concerns associated with training ranges. In FY06, matured acoustic emission data acquisition techniques and models for various weapon systems. In FY07, integrate noise prediction and management tools into Army range design protocols. In FY08, will complete initial blast noise complaint risk study criteria and develop impulse noise prediction models. In FY09, will complete complaint risk guidelines and a new noise modeling calculation engine for peak noise event based on statistical data and numerical analysis propagation algorithms.	1272	1932	2026	2068
Small Business Innovative Research/Small Business Technology Transfer Programs		35		
Total	1272	1967	2026	2068

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**	**025**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
025 POLLUTION PREVENTION TECHNOLOGY	2979	3433	3532	3645	3725	3799	3883	3968

A. Mission Description and Budget Item Justification: The objective of this project is to mature and demonstrate pollution prevention advanced technologies required to comply with regulations mandated by federal, state, and local environmental and health laws. Technology thrusts under this project include: (1) demonstration of new coating materials, systems, and processes to comply with existing and new national laws and local regulations; (2) demonstration of advanced nanocomposite packaging systems and advanced technologies for the reuse/recycling of solid waste resulting from packaging during deployed operations required to meet the operational needs of the Future Force; (3) demonstration of advanced technologies to enable sustainment of rocket and missile propellant production and maintenance facilities and training ranges through elimination or significant reduction of environmental impacts. These technologies are transitioned from PE 0602720A, project 895, and will ensure that advanced energetic materials required for Future Combat Systems (FCS) high performance munitions are developed that are compliant with environmental and health laws and meet weapons lethality and survivability goals. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP), and supports the Army Strategy for the Environment. Work in this project is performed by the Research, Development, and Engineering Command's (RDECOM) Army Research Laboratory (ARL) located at Aberdeen, MD, the US Army Natick Soldier Center (NSC) located at Natick, MA, the Armaments Research, Development, and Engineering Center (ARDEC) located at Picatinny Arsenal, NJ, the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) located at Huntsville, AL, and the Tank-Automotive Research, Development, and Engineering Center (TARDEC) located at Warren, MI.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Sustainable Painting Operations: In FY06, matured hazardous air pollutant (HAP)-free solvents, cleaners, and thinners used in coating operations and processes. In FY07, reformulate HAP-free sealants and adhesives used in weapon system maintenance, production, and industrial processes. In FY08, will design and evaluate touch-up kits containing HAP-free paints for on-system field maintenance. In FY09, will investigate HAP-free coatings for production of medium and large caliber ammunition. Solid Waste Diversion: In FY06, demonstrated solid waste minimization techniques for base camp operations. In FY07, mature and evaluate advanced nanocomposite packaging technologies to reduce the amount of packaging debris generated during deployed operations. In FY08, will optimize nanocomposite packaging structures and evaluate prototype packages in an operational environment. Compliant Ordnance Lifecycle: In FY06, selected and demonstrated most promising benign propellant alternative that eliminates or significantly reduces environmental impacts. In FY07, demonstrate alternatives to perchlorate and hydrazine propellants and non-toxic pyrotechnic compositions. In FY08, will evaluate environmental health of new propellants, pyrotechnics and explosives, and will demonstrate and refine alternative rocket propellants/motor combinations. In FY09, will scale-up synthesis of environmentally benign RDX replacement candidates for demonstration in munitions.	2979	3337	3532	3645
Small Business Innovative Research/Small Business Technology Transfer Programs		96		
Total	2979	3433	3532	3645

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**	**03E**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
03E	ENVIRONMENTAL RESTORATION TECHNOLOGY	7797	8533	9424	10736	10850	10933	11173	11419

A. Mission Description and Budget Item Justification: The objective of this advanced technology development project is to mature and demonstrate technologies transitioned from program element (PE) 0602720A (Environmental Quality Technology), project 835 that improve the Army's ability to achieve cost-effective environmental restoration of contaminated (unexploded ordnance, military unique compounds, and energetics) sites at its installations, active, and inactive ranges, its rework and production facilities, and the battlefield. Technologies matured within this project enable the Army to cost effectively address current environmental liabilities resulting from soil and groundwater contamination. Current and planned efforts enable the Army to efficiently characterize, evaluate, assess, and remediate soil and groundwater at installations, ranges, facilities, and during battlefield operations. Efforts also identify ways to economically comply with the myriad of federal, state, and host country regulations dealing with contaminated soil and groundwater. A key aspect of this work is the enhancement of risk assessment techniques that can more accurately display the environmental risks associated with munitions residues. This program includes pilot scale field studies to establish technological feasibility and assess performance and productivity of the risk assessment techniques, and includes technology transition from the laboratory to demonstration/validation funded under PE 0603779A (Environmental Quality Technology - Dem/Val), project 04E. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Unexploded Ordnance (UXO): In FY06, developed UXO discrimination models for wide-area transmitter sensor systems and for multi-axis sensor systems. In FY07, develop and evaluate a model for active range real-time UXO discrimination, and the Management Aid for UXO Detection Efforts (MAUDE) software application which assesses key geophysical and environmental site parameters and assists the site remediation manager with sensor/method/system site-specific selection guidelines for active range remediation. In FY08, will complete development of rapid computational modeling for active range scenarios. Will conduct field evaluations of rapid route survey and evaluation systems, of target/berm/bunker survey and assessment systems, and of a multi-sensor projectile impact assessment, positioning, and characterization system for range operations. In FY09, will conduct field evaluations of specialized instrumentation for targets, berms, and bunkers for monitoring impacts and condition assessment. Will investigate innovative technologies for range UXO maintenance and for mitigation of unique and emerging UXO.	1481	2162	2304	1761
Hazard/Risk Assessment Tools for Toxicity of Munitions Constituents (MCs) and Munitions and Explosives of Concern (MECs): In FY06, assessed non-intrusive methods for identification and risk assessment of toxic industrial chemicals and materials and developed conceptual techniques and procedures for incorporation into Intelligence Preparation of the Battlefield (IPB) practices and conducted gap analyses. In FY07, complete migration of Adaptive Risk Assessment Modeling System (ARAMS) to the higher order modeling technique, initiate adapting ARAMS to live fire range assessment, and continue preparation of geospatial environmental risk visualization techniques for incorporation into the IPB process. In FY08, will initiate advanced toxicogenomics of molecular tools to quantitatively assess MEC exposure, mathematical models of toxicity and effects due to existing, well characterized MEC, predicting multiple stressor impacts on toxicity, MEC toxicity mechanisms in ecological species, and species developmental pathways affected by MECs. In FY09,	936	1542	2466	5311

will conduct cross-species validation of MEC effects. Will initiate advanced protocols for rapid screening and monitoring of ecological impact of MECs. Will initiate advanced computational chemistry predictions of chemical structures and physical properties of adsorbed explosives and organophosphorus compounds in soils. Will conduct technology demonstration of exposure quantification metrics for select representative nanomaterials.				
In Situ Remediation Technologies for Contaminated Groundwater and Soils: In FY06, matured in situ physical and biological cleanup processes for explosives in groundwater, and advanced in situ chemical and plant uptake treatment methods to immobilize inorganics at small arms training ranges. In FY07, finalize in situ physical and biological cleanup processes for explosives in groundwater with process guidance, specifications, and protocols and continue to mature in situ chemical and plant uptake treatment methods to immobilize inorganics on berms at small arms training ranges. In FY08, will mature near-surface biostabilization and phytostabilization technologies for inorganics on small arms firing ranges (SAFRs). Will construct integrated assessment models for inorganics on SAFRs. In FY09, will finalize and validate remediation/management of inorganic residues on SAFRs with process guidance, specifications, and protocols.	1782	1551	897	177
Characterization, Evaluation and Remediation of Distributed Source Contamination on Army Ranges: In FY06, matured and initiated early stage demonstration of a real-time detection capability and topical treatment methods for high concentration source zones of explosives and propellants. In FY07, complete a real-time detection capability for high concentration source zones for explosives and propellants and evolve geo-statistical methods to predict contaminant distribution patterns; mature in situ explosive treatment processes for distributed contamination on active ranges. In FY08, will complete field evaluation of statistically valid range characterization/sampling protocols for MC sources on active range soils and surface waters. Will continue maturing on-site, topical alkaline hydrolysis of impact area explosives and quantifying the effects of wildfire control practices on active ranges. In FY09, will conduct field evaluations of advanced spatial components for range risk assessment in Adaptive Risk Assessment Modeling System (ARAMS). Will quantify the effects of wildfire control practices on active ranges. Will perform field evaluation of on-site, topical alkaline hydrolysis of impact area explosives.	2408	1939	2350	2319
Long Term Monitoring Applications: In FY06, matured adaptations of commercially available direct-push wells for long term monitoring applications, and evaluated field portable sensors, sampling, and analysis methods. In FY07, integrate direct-push wells coupled to in situ real time sensing and analysis technologies, and evaluate integrated long term monitoring system designs for near real-time sampling, measurement, analysis, and information transmission. In FY08, will complete advance development of prototype gene signature array microchip sensor for MCs. Will evaluate field detection of MCs and emerging contaminants with negative ion miniature mass spectrometry achieved. Will conduct field evaluation of catalytic DNA and Surface Plasmon Resonance (SPR) affinity array sensors. In FY09, will complete advanced development of in situ biosensor technologies implemented in direct push wells. Will conduct final field evaluation of gene signature array sensor and of negative ion miniature mass spectrometer for multiple targets and multiple matrices.	1190	1144	1407	1168
Small Business Innovative Research/Small Business Technology Transfer Programs		195		
Total	7797	8533	9424	10736

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603734A - Military Engineering Advanced Technology**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	20868	27688	6837	7676	5754	6786	6935	7088
T08	COMBAT ENG SYSTEMS	7068	7761	6837	7676	5754	6786	6935	7088
T13	Stationary Power & Energy Tech Demonstrations (CA)	9871	13994						
T15	MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)	3929	5933						

A. Mission Description and Budget Item Justification: The objective of this advanced technology development program element (PE) is to mature and demonstrate advanced military engineering and battlespace environment technologies that support the Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. Technologies demonstrated within this PE are transitioned from PE 0602784A (Military Engineering Technology). Military engineering technologies demonstrated include Joint Rapid Airfield Construction (JRAC) technologies that support the expedient upgrading of existing airfields and rapid construction of new contingency airfields. Battlespace environment technologies demonstrated include Battlespace Terrain Reasoning and Awareness (BTRA) and Joint-Geospatial Enterprise Services (J-GES) technologies. BTRA enables the warfighter to understand the impact of the terrain and weather effects during planning and execution of military operations. The J-GES program matures and demonstrates technology that supports network centric delivery and update of geospatial data and services to all echelons for battle command planning and mission rehearsal. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	21390	7848	6890	7690
Current BES/President's Budget (FY 2008/2009)	20868	27688	6837	7676
Total Adjustments	-522	19840	-53	-14
Congressional Program Reductions		-106		
Congressional Rescissions				
Congressional Increases		20150		
Reprogrammings	-522	-204		
SBIR/STTR Transfer				
Adjustments to Budget Years			-53	-14

Twelve FY07 congressional adds totaling $19312 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($958) Fuel Cell Hybrid Gen Sys w/Ramgen Jet Tech
($958) Def Apps for Thermo-Electric Power Gen Devices
($1294) Def Apps of Stationary Carbonate Fuel Cells
($959) Real-time Drinking Water Security Program
($1294) Accelerating the Transition of Fuel Cell Systems
($3115) Advanced Tactical Fuels
($1246) Fuel Cell Mobile Electric Power System
($3738) Fuel Cell Power for Continuity of Operations
($2875) USArmy Adv Structures & Composites in Construction
($959) Concrete Sealing System
($958) Counter Rocket, Artillery,Mortar (C-RAM) Armor Dev
($958) Frameworks f/Rapid Engnr Design Optim SW

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603734A - Military Engineering Advanced Technology**	**T08**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
T08 COMBAT ENG SYSTEMS	7068	7761	6837	7676	5754	6786	6935	7088

A. Mission Description and Budget Item Justification: The objective of this advanced technology development project is to mature and demonstrate advanced military engineering and battlespace environment technologies that support the Future Force and, where feasible, exploit opportunities to enhance Current Force capabilities. Technologies demonstrated within this project are transitioned from program element 0602784A (Military Engineering Technology), projects 855, T40, and T42. Joint Rapid Airfield Construction (JRAC) technologies support the expedient upgrading of existing airfields and rapid construction of new contingency airfields. Battlespace Terrain Reasoning and Awareness (BTRA) technologies enable the warfighter to understand the impact of the terrain and weather effects during planning and execution of military operations. BTRA completed in FY06, and will be advanced through future work in Battlespace Terrain Reasoning and Awareness - Battle Command (BTRA-BC), an Army Technology Objective (ATO). The Joint-Geospatial Enterprise Services (J-GES) research program matures and demonstrates technology that supports network centric delivery and update of geospatial data and services to all echelons for battle command planning and mission rehearsal. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). The US Army Engineer Research and Development Center, headquartered at Vicksburg, MI, executes the project work.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Joint Rapid Airfield Construction: In FY06, evaluated select maintenance and repair techniques for contingency airfields and developed integrated site selection tools including integrated advanced site assessment models, terrain analysis technologies, and performance prediction modeling to optimize contingency airfield site selection. In FY07, demonstrate JRAC technologies for site selection, enhanced construction, and rapid soil stabilization for C-17 contingency airfield operations during the Talisman Sabre Exercise at Bradshaw Field Training Area in Northern Territory, Australia.	3943	2027		
Joint-Geospatial Enterprise Services (J-GES): In FY06, utilized a network-centric architecture to demonstrate basic geospatial information services from multiple locations and developed technology that supports network centric delivery and update of geospatial data and services. In FY07, expand J-GES capabilities including developing a technical architecture that will support experimentation. With the architecture developed, perform initial experiments focused on determining where geospatial services should be employed and the value of these services to the military decision-making process. In FY08, will continue experimentation focused on evaluating geospatial data/information flow across multiple echelons to support battle command planning and mission rehearsal, as well as identifying transition opportunities for these geoservices to Battle Command and Intelligence, Surveillance, and Reconnaissance programs. In FY09, will transition urban-focused geospatial research and technologies developed under PE 0602784/project 855 into the J-GES environment for experimentation and validation.	1917	2715	1147	1286
Battlespace Terrain Reasoning and Awareness Demonstrations: In FY06, established a terrain reasoning capability within the Multi-cell and Dismounted Experimentation Program to measure the benefit of terrain reasoning for informed command and control decision making; conducted initial demonstration of tactical bandwidth compatible situation and threat assessment tools within battlefield functional area processes and battlefield operating systems architectures. BTRA transitioned to an advanced development program entitled Battlespace Terrain Reasoning and Awareness - Battle Command (BTRA-BC).	1208			

Battlespace Terrain Reasoning and Awareness - Battle Command(BTRA-BC): In FY07, test, evaluate, and validate spatial and predictive analysis tools, some of which were developed under BTRA, through experiments within simulated battle command and intelligence, surveillance and reconnaissance environments leveraging the J-GES as a specific beta evaluation. In FY08, will accredit sensor effects software developed using CMMI processes, to be deployed to Commercialized Joint Mapping Tool Kit program of record. In FY09, will demonstrate and experiment within J-GES tools designed for urban data and urban routing structures.		2867	5690	6390
Small Business Innovative Research/Small Business Technology Transfer Programs		152		
Total	7068	7761	6837	7676

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603772A - Advanced Tactical Computer Science and Sensor Tech**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	40516	70248	67011	34448	27856	29096	33044	33875
101	TACTICAL AUTOMATION	11136	13467	16172	16407	13495	14622	17002	17307
1AA	Tactical Computer Science Demonstrations (CA)	4884	9395						
1AB	SENSOR DEMONSTRATIONS (CA)	5467	8851						
243	SENSORS & SIGNALS PROC	19029	38535	50839	18041	14361	14474	16042	16568

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates technologies to achieve information dominance in order to accomplish net-centric operations for the Army's Future Force and, where feasible, to enhance the Current Force capabilities. To gain and maintain battlefield dominance, the Warfighter needs to understand, decide, and act more rapidly than his adversaries. Project 101, Tactical Automation, matures and demonstrates technologies that will allow forces to effectively collect, analyze, transfer, and display information in a net-centric battlefield environment. It develops architectures and provides technologies to enable synchronized Command and Control (C2) during rapid, mobile, dispersed, and joint operations. It demonstrates technologies necessary for integrated battlefield situational awareness (SA), force synchronization (to include coordination between manned and unmanned assets), split-based, and On-the-Move (OTM) C2 operations. Project 243, Sensors and Signal Processing, matures signal processing and fusion technologies for Army sensors; matures and demonstrates radio frequency (RF) systems to track and identify enemy forces and personnel; matures and demonstrates multi-sensor control and correlation for improving reconnaissance, surveillance, tracking, and target acquisition. Projects 1AA and 1AB fund congressional special interest efforts.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this PE contains no duplication with any effort within the Military Departments and is fully coordinated with PE 0602270A (EW Technology), PE 0602782A (Command, Control, Communications Technology), PE 0603008A (Electronic Warfare Advanced Technology), PE 0602120 (Sensors and Electronic Survivability), and PE 0603270A (EW Technology). Work in this PE is performed by the Army Research, Development, and Engineering Command, Communications-Electronics Research, Development, and Engineering, Center (CERDEC), Fort Monmouth, NJ.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603772A - Advanced Tactical Computer Science and Sensor Tech**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	44991	64604	65657	32015
Current BES/President's Budget (FY 2008/2009)	40516	70248	67011	34448
Total Adjustments	-4475	5644	1354	2433
Congressional Program Reductions		-12289		
Congressional Rescissions				
Congressional Increases		18450		
Reprogrammings	-4475	-517		
SBIR/STTR Transfer				
Adjustments to Budget Years			1354	2433

Ten FY07 congressional adds totaling $17684 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($2300) Bi-Directional English-Iraqi Translation System
($959) Hand-held Phraserlator Translation Technology
($959) Aviation Responsive Maintenance System
($3019) Comms Electronics Cost Module (CECM)
($1869) SharedVision
($958) Digital Array Radar Technology Development
($4410) Hyperspectral Imaging & SAR for UAVs
($958) Lgtwt Counter Mortar Radar Base Protection Systems
($1294) Sensor Visualization and Data Fusion
($958) Radar Tag Emitter

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603772A - Advanced Tactical Computer Science and Sensor Tech**	**101**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
101 TACTICAL AUTOMATION	11136	13467	16172	16407	13495	14622	17002	17307

A. Mission Description and Budget Item Justification: This project matures and demonstrates command and control architectures and technologies for Future Force and, where applicable, for Current Force information dominance. For the Army Future Force, a critical advancement in battle command is in the use of automated information technologies embedded throughout its warfighting units that enable them to use information as an element of combat power. This project supplies the tools to provide commanders at all echelons more timely and effective information and allows them to command from anywhere on the battlefield. This will allow Future Force commanders to understand, decide, and act faster than their adversaries, resulting in increased OPTEMPO, improved force synchronization, and reduced fratricide. This project matures advanced computer science and technology solutions addressing: information storage and retrieval, digital transfer, and display of horizontal battlefield situational awareness (SA) and position/location; a common view of the battlefield; synchronization of combined and joint force operations; and Command and Control (C2) On-the-Move (OTM). It matures key technologies in the following areas: automated decision support; advanced database design and distribution; dynamic digital display and manipulation; web-based architectures for intelligent software agents and mission execution monitoring; and mobile adaptive computing. Advanced C2 software services for the Current Force, the brigade combat team (BCT) and echelons above brigade are matured and demonstrated, including efforts involving Command and Control of robotic entities which mature and demonstrate software services optimized for unmanned air and ground robotic systems. Joint developer/warfighter experiments will be conducted in coordination with PM FCS BCT, Training and Doctrine Command (TRADOC) and Research, Development, and Engineering Command (RDECOM) partners.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army RDECOM, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Network Enabled Battle Command (NEBC): In FY06, matured and demonstrated technologies to support the interfacing and information exchange management between the BCT and echelons above brigade (EAB) C2 software applications; matured intelligent search/retrieval technology and blue force predictive analysis tools for execution assessment/adjustment decision support and demonstration at the C4ISR OTM; transitioned decision support services to the Product Manager Global Command and Control System Army Joint Web Common Operating Picture (COP) program. In FY07, demonstrate and transition information search and retrieval technology and execution decision support tools into PM Battle Command, Joint Tactical COP Workstation and Maneuver Control System architecture; mature information models to represent blue and red force resources, capabilities, and behaviors. In FY08, will mature and demonstrate software to support the interfacing, and information management and exchange between BCT and EAB C2 software applications; will mature and deliver final software products for running estimate, information search and retrieval, and decision support services. In FY09, will mature network monitoring service for application in dynamic control of the Global Information Grid from tactical through enterprise level network architectures; will demonstrate network monitoring services that enable other systems to monitor their own throughput and packet loss to enable dynamic adjustment and optimization of network utilization; will demonstrate how quality of service metrics can be utilized to help intelligently manage the resources of distributed C2 service providers. Work related to this effort is also being accomplished under	4300	6100	7292	5120

PE/project: 0602782A/779.				
Command and Control of Robotic Entities (C2ORE): In FY06, prepared for and participated in Joint Expeditionary Force Experiment (JEFX06), C4ISR OTM experiment, and FCS Experiment 1.1; designed tactical Battle Command services for Unattended Ground Sensors (UGSs) and a scenario for experimentation with Unit of Action Maneuver Battle Laboratory. In FY07, mature and demonstrate tactical battle command services for unmanned aerial vehicles (UAVs); prepare for and execute a live experiment with up to three UGS clusters, three unmanned ground vehicles (UGVs), and one UAV; analyze experimental data to assess and provide software improvements to the tactical battle command services. In FY08, will mature and demonstrate tactical battle command services for unmanned ground vehicles; will prepare for and participate in experimentations and a C2ORE lab demonstration at Fort Monmouth, NJ; will mature air/ground collaboration software services. In FY09, will mature tactical battle command services and air/ground collaboration services to include UGSs, UAVs, and UGVs and demonstrate all in a relevant environment; will execute a C2ORE capstone demonstration with up to five UGS clusters, five UGVs, and three UAVs; will analyze experimental data and provide experimentation and analysis report detailing lessons learned and metrics evaluated.	3846	7081	8880	9287
Joint Force Projection (JFP) Advanced Concept Technology Demonstration (ACTD): In FY06, developed and demonstrated an initial Joint Reception, Staging, Onward Movement, and Integration (JRSOI) bridge tool to join strategic and theater deployment and distribution processes that provides combatant commanders with enhanced capabilities to analyze, plan, execute, and assess force projection at the strategic and operational levels; integrate JRSOI into a mission capability package (MCP). In FY07, will mature the Force Projection MCP within the next generation Net-Enabled Command Capability (NECC) environment; will support JFP integration into USCENTCOM, USTRANSCOM, and JFCOM exercises; will finalize transition of JFP technologies to NECC.	1610	180		
Battle Space Awareness abd Positioning: In FY09, will build on the munitions-focused Common Guidance Common Sense Micro-Electro Mechanical System (MEMS) Inertial Measurement Units (IMUs) effort and mature the MEMS IMUs for suitable precision and accuracy for dismounted Soldier and tactical vehicle applications; will evaluate MEMS preliminary design models of gyroscopes in a laboratory environment and develop prototype gyroscopes suitable for integration into a MEMS IMU for evaluation in a relevant environment. Work related to this effort is also being accomplished under PE/project: 0602782A/779.				2000
Distributed Command and Control On-the-Move: In FY06, demonstrated a multi-echelon battle command construct representing both Current and Future Force battle command systems. The associated experimentation in a relevant on-the-move environment laid the groundwork for the evolution of current force battle command systems to future force capabilities.	1380			
Small Business Innovative Research/Small Business Technology Transfer Programs		106		
Total	11136	13467	16172	16407

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603772A - Advanced Tactical Computer Science and Sensor Tech**	**243**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
243 SENSORS & SIGNALS PROC	19029	38535	50839	18041	14361	14474	16042	16568

A. Mission Description and Budget Item Justification: This project matures and demonstrates improved ground based radar, sensor fusion, and correlation technologies for Future Force information dominance and where feasible exploits opportunities to enhance Current Force capabilities. The Suite of Sense Through the Wall Systems will mature techniques for detection of personnel and objects through multiple wall types. The Multi-Mission Radar (MMR) effort matures Multi-mission HMMWV mounted radar technology to support air defense, counter-battery, and air traffic control missions within a single system to enhance Future Force mobility and agility. MMR will be self-contained to process target data, identify aircraft/unmanned aerial vehicles (UAVs), and classify artillery, mortar, and rockets. All target data will be distributed to relevant units in the battlefield through network centric channels. Sensor fusion efforts demonstrate sensor management and data correlation, link analysis, and relationship discovery fusion services of a multi-INT fusion system. Sensor and simulated sensor candidates may include moving-target-indicator (MTI)/synthetic aperture radar (SAR), electro-optical/infrared (EO/IR), signals intelligence (SIGINT), measurements and signatures intelligence (MASINT), HUMINT, and biometrics technologies. This project will mature and demonstrate technologies for wide area reconnaissance, surveillance, tracking, and targeting of individuals in complex and urban environments and asymmetric warfare. Technologies will be matured with significant leveraging of achievements from industry, Defense Advanced Research Projects Agency (DARPA), and other services.

The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research, Development, and Engineering Command, Communications - Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth NJ.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Multi-Mission Radar (MMR): MMR demonstrates the ability to deploy a single sensor that can perform multiple missions; air and missile defense (AMD) engagements of rockets, artillery, mortars, UAVs, cruise missiles, and rotary-and fixed-wing aircraft; counter-fire target acquisition (CTA); air defense fire control (ADFC); Air Defense Surveillance (ADS); and air traffic control (ATC). In FY06, performed system and subsystem test; performed two sets of radar 90 degree CTA system tests against dedicated targets to validate performance; conducted system test demonstration of CTA, ADS, ATC, and ADFC capabilities for user community. In FY07, complete integration and test of expanded 360 Degree CTA capability, demonstrate integration with extended-light weight counter mortar radar, demonstrate cueing to external airborne sensor for mobile-shooter location; demonstrate a fully tested 360 degree MMR system and deliver prime item development specifications to Program Manager Radars suitable for moving into a system development and demonstration phase.	6100	2881		
Suite of Sense Through the Wall (STTW) Systems: STTW matures and demonstrates technologies to provide mounted/dismounted users with the capability to detect, locate, and see personnel with concealed weapons and explosives who are hidden behind walls, doors, and other visible obstructions. In FY06, conducted lab and user testing of STTW prototypes; utilized experiments to characterize urban and complex terrain phenomenology; matured and demonstrated techniques for the detection of stationary personnel through drywall, brick, and mortar materials. In FY07, mature and demonstrate integrated personnel detection/Concealed Weapon Detection (CWD)/Concealed Explosive Detection (CED) systems with greater standoff capability and increased probability of detection; will conduct lab testing of individual STTW sensors against multiple wall types; will develop techniques for detection of stationary personnel through multiple wall	5861	7062	6358	

types; demonstrate handheld and small unmanned ground vehicle STTW during the Air Assault Expeditionary Force (AAEF) Experiment and Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) On-the-Move (OTM) experiment. In FY08, will complete integration of personnel/CWD/CED prototypes; will conduct final development testing of integrated STTW CWD/CED technology demonstrators against multiple wall types; will conduct additional experiments in urban and complex environments to continue evaluation of new operational concepts/Tactics, Techniques, and Procedures; transition complete suite of STTW systems to PEO Solider (Soldier borne) and PM RUS (SUGV/UGV mounted). Work related to this effort is also being accomplished under PE/project: 62270/442.				
Foliage Penetrating (FOPEN) Radar for Unmanned Aerial Vehicles (UAV): This effort matures and demonstrates a FOPEN radar capability to meet the size, weight, and power requirements for a Class IV fixed wing UAV. This effort leverages efforts from the FOPEN Advanced Concept Technology Demonstration (ACTD) (FY03-FY06 in program element (PE) 0603750D8Z, and PE/project 0603762E/SGT-04) capability from manned aircraft to Class IV UAV. Advancements in both radar and exploitation processing technology will enable increased radar performance to include ground and non-metallic building penetration for detection of hidden roadside target/weapons caches. In FY06, developed specification for UAV FOPEN radar system and investigated design concepts and approaches. In FY07, design hardware for airborne radar system including transmitter, antenna, receiver, and processor to provide longer standoff range, wider area coverage, higher sensitivity, and higher probability of detection/lower false alarm rate requirements than ACTD system; develop interface control documents for installation onto the Class IV UAV. In FY08, will fabricate system demonstrator and spares (specific steps include: integration and test of transmitters, antennas, receivers, and processors; lab tests for sensitivity/calibration, motion compensation, frequency notching, interface and control, modes, mission planning, built-in-test, and data link functions; and environmental and ground end to end acceptance tests); will complete air worthiness release documentation and testing for manned surrogate UAV platform; will conduct radar performance flight testing on manned surrogate UAV. In FY09, will complete flight test on manned surrogate UAV to include performance testing; will install system on target UAV and will verify radar performance and remote operation via the data link; will quantify and document system performance.	1000	12736	32761	6041
Sensor Fusion: This effort develops and demonstrates automated tools to solve the fusion, exploitation, and sensor management/cross-cueing problems associated with prosecuting and tracking individuals, recognizing their patterns of association, and thereby, being able to track the organizations they form. This effort allows the commander to target significant individuals and to understand the organizations exerting influence in his area of operation sufficiently to disrupt or attack the organizational infrastructure. In FY06, completed system hardware design and level one fusion algorithms/software for automated data correlation, sensor cross-cueing, and target tracking; selected architecture, integrated SAR/MTI, EO/IR and SIGINT sensors, and conducted limited testing in the C4ISR OTM experiment at Fort Dix. In FY07, mature fusion service-oriented architecture (SOA)-compliant framework, which provides interoperability via the DCGS-A Integration Backbone (DIB); establish a proxy for priority intelligence requirement (PIR) management service with limited functionality; begin software development for: multi-INT correlation service, a contextual data mediator service, relationship discovery services, and sensor management service; design platform installation; characterize baseline multi-INT data set; select a low-cost, flexible, commercial processing architecture. In FY08, will continue development/integration/refinement on all software services and SOA framework; integrate PIR management service; will demonstrate mature software services. In FY09, will finalize services development and integration and test in the integration lab; will demonstrate mature software services in Army or Joint experiments; will conduct final high fidelity lab experiments and demonstrations of fusion automation and demonstrations of fusion automation and answering capabilities. Work related to this effort is also being accomplished under PE/project: 62270/442.	6068	3727	3920	3500
Ground Moving Target Indicator (GMTI) and Imaging Surveillance Radar: This effort demonstrates an all-weather GMTI and Synthetic Aperture Radar (SAR) for all-terrain (foliated and open) detection and tracking of mounted and dismounted threats in a package form-fit-		9604	4800	5000

function compatible with a Class IV rotary wing UAV. This effort is maturing DARPA investments in GMTI and synthetic aperture radar and applying lessons learned to build a multi-function radar system that will satisfy Class IV UAV size weight and power requirements. In FY07, begin radar development; identify and purchase all radar components and test equipment in preparation for tower testing in FY08; integrate a suite of tools to include scenario generation, radar modeling, tracker modeling, tracker evaluation, and visualization from the Air Force Research Lab and other Army sources provide an integrated modeling environment. In FY08, will mature radar model and existing trackers; will continue hardware and software development; will conduct component testing; will assemble radar components; will conduct tower testing of the prototype system to support risk reduction and acquire data needed for the development of signal processing algorithms; will develop MTI exploitation approach; will integrate software package into the development environment for evaluation and stressing under varying operating conditions. In FY09, will complete radar development and tower testing; will integrate system onto a manned surrogate platform and initiate flight testing; will collect tower and flight test data to support development of adaptive MTI processing algorithms, advanced motion compensation techniques and advanced exploitation and evaluation tools.				
Measurement and Signature Intelligence Technologies (MASINT) for clandestine tagging, tracking, and locating: This effort matures and demonstrates MASINT technologies capable of detecting, tracking, and/or identifying human activities and/or infrastructures. The emphasis is to identify appropriate approaches, demonstrate embedded processing, and mature algorithms for multi-mode fusion of sensor data. Candidate technologies include: fiber optic seismic/magnetic technologies (highly sensitive for detection of walking personnel with/without weapons and/or tunneling detection); air deployable (air droppable) networked sensor system for a jungle environment (integration of seismic/acoustic sensor with jungle canopy relay); human infrastructure detection technologies (algorithms, sensors, etc); radio frequency MASINT detector, ultra-light multi target indicator radar for unattended ground sensors and unmanned air vehicles. In FY08, will evaluate candidate technologies for tagging, tracking and locating, and select the most viable technologies to pursue for near-term demonstration; will demonstrate/test selected technologies for potential spiral transition to the user community. In FY09, will enhance demonstrators and/or evaluate new candidate technologies for near-term prototype development; will integrate selected technologies into a system demonstrator; will demonstrate/test selected technologies for potential spiral transition to the user community. Work related to this effort is coordinated with Army Research Lab efforts in PE/project 0602120/H16.			3000	3500
Cueing Sensor: This effort matures and demonstrates low cost infrared sensors that detect rocket propelled grenades, anti-tank guided missiles, and tank fired kinetic energy and high energy anti-tank rounds and then cue active protection system for Army vehicles. In FY07, mature and demonstrate dual band focal plane arrays, algorithms, and processing. Work related to this effort is also being accomplished under PE/projects: 62120/H15; 62270/A442; 63270/K16.		1497		
Small Business Innovative Research/Small Business Technology Transfer Programs		1028		
Total	19029	38535	50839	18041