UNCLASSIFIED

Supporting Data FY 2006/2007 President's Budget
Submitted to OSD – February 2005

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

UNCLASSIFIED

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS
OF THE
RESEARCH, DEVELOPMENT, TEST AND
EVALUATION, ARMY
FY 2006/2007
PRESIDENT'S BUDGET SUBMISSION
FEBRUARY 2005

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 2006/2007 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 2004 through FY 2007.

2. Relationship of the FY 2006/2007 Budget Submission to the FY 2005 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
0603639A/656	Advanced Munitions Demonstration	0603004A/232
0603474A/C09	Soldier Support Equipment – AD	0603827A/S52
0603474A/669	Clothing and Equipment Adv Development	0603827A/S53
060639A/656	Advanced Munitions Dem	0603004A/232
0603774A/131	Unique Identification	0603773A/U02
0603801A/B45	ACIS Advanced Development	0603827A/S51
0603802A/AS2	Small Arms Improvement	0603827A/S54
0603802A/AS3	Objective Individual Combat Weapon	0603827A/S55
0604645A/F59/F60/F62	FCS – Reconnaissance Platforms & Sensors	0604645A/F52
0604645A/F63/F64/F65	FCS – Unmanned Ground Vehicles	0604645A/F53
0604645A/F66/F67	Unattended Sensors	0604645A/F54
0604645A/F68/F69	Sustainment	0604645A/F55
0604645A/F70/F71	Manned Ground Vehicle	0604645A/F57
0604647A/F58	Non-Line of Sight Launch System	0604646A/F72

OLD PE/PROJECT	NEW PROJECT TITLE	NEW PE/PROJECT
0604713A/680	Mounted Warrior	0604827A/S56
0604713A/667	Land Warrior	0604827A/S57
0604713A/668	Soldier Enhancement Program	0604601A/S58
0604713A/C40	Soldier Support Equipment – ED	0604601A/S59
0604713A/L40	Clothing & Equipment	0604601A/S60
0604801A/C45	ACIS Engineering Development	0604601A/S61
0604802A/134	Objective Individual Combat Weapon	0604601A/S62
0604802A/AS1	Small Arms Improvement	0604601A/S63
0604802A/AS6	Common Remotely Operated Weapon Systems (CROWS)	0604601A/S64
0604802A/613	XM395 Precision Guided Mortar Munitions	0604802A/AS8
0604804A/461	Joint High Speed Vessel	0208058A/JH1
0303150A/C86	Joint Command and Control - Army	0303158A/714

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

FROM PE/PROJECT	PROJECT TITLE	TO PE/PROJECT
0603869A/01B	Patriot/MEADS Combined Aggregate Program (CAP)	0604869A/M06
0604865A/01C	Patriot Advanced Capability (PAC)-3	0603869A/01B

C. Establishment of New FY 2006/2007 Program Elements/Projects. There are no major system new starts. Minor new initiatives for FY 2006/2007 are shown below with asterisks. The remaining programs listed are outyear initiatives, restructures beyond FY 2006/2007, or were previously funded from other Defense appropriations.

TITLE	PE/PROJECT
Agile Integration & Demonstration	0603125A/DF5
Armed Reconnaissance Helicopter	0604220A/53H*
General Fund Enterprise Business System (GFEBS)	0604822A/GF5*
HQDA Decision Support Tools & Services	0605718A/S02*
Training & Doctrine command (TRAC) Modeling & Simulation & Training	0605718A/S03*
Simulation Technology (SIMTECH) Program	0605718A/S05
Apache Block III	0203744A/D17

D. FY 2006 programs for which funding existed in the FY 2005 Amended President's Budget Submit (March 2004), but which are no longer funded beginning in FY 2006.

PE/PROJECT	TITLE	BRIEF EXPLANATION
0603305A/TR3	MTHEL	Program Complete
0603639A/694	Medium Caliber Ammunition	Program Terminated
0603639A/64B	105mm Conventional Tank Ammunition	Program in Production
0603639A/694	120mm conventional Ammunition	Program in Production
0604329A/013	Joint Common Missile	Program Terminated
0604611A	Javelin	Program in Production
0604710A/L75	Profiler	Program Completed
0604819A	LOSAT	Program Terminated
0604823A/L85	Firefinder AN/TPQ-47*	Program Terminated

* Also known as Phoenix Battlefield Sensor System AN/TPQ-47

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

0203806A/Z02	0603005A/C66	0603710A/C65
0203808A/E11	0603009A/B18/B31	0604328A/C71
0301359A	0603020A/B77/B84/B96	
0602122A/B72/622	0603322A/B92	

4. Performance Metrics. Performance metrics used in the preparation of this justification book may be found in the FY 2006 Army Performance Budget Justification Book, dated 18 February 2005.

Department of the Army
FY 2006 RDT&E Program
President's Budget FY 2006/2007
Summary

Exhibit R-1

08-Feb-2005

Summary Recap of Budget Activities	Thousands of Dollars FY 2004	FY 2005	FY 2006
Basic Research	369,208	392,864	307,594
Applied Research	1,046,041	1,117,659	671,302
Advanced Technology Development	1,187,066	1,385,067	756,359
Advanced Component Development and Prototypes	874,216	874,325	364,973
System Development and Demonstration	4,499,746	4,580,173	5,225,675
Management Support	1,140,384	1,173,909	1,092,650
Operational System Development	1,085,560	1,033,622	1,315,271
Total RDT&E, Army	10,202,221	10,557,619	9,733,824

Line No.	Program Element Number	Act	Item	Thousands of Dollars FY 2004	FY 2005	FY 2006
	Basic research					
1	0601101A	01	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	23,138	23,077	20,542
2	0601102A	01	DEFENSE RESEARCH SCIENCES	151,079	163,443	137,898
3	0601103A	01	UNIVERSITY RESEARCH SCIENCES (H)	82,473	83,959	67,201
4	0601104A	01	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	96,549	100,066	81,953
5	0601105A	01	FORCE HEALTH PROTECTION	15,969	22,319	0
	Total: Basic research			369,208	392,864	307,594
	Applied Research					
6	0602105A	02	MATERIALS TECHNOLOGY	40,211	50,788	17,559
7	0602120A	02	SENSORS AND ELECTRONIC SURVIVABILITY	25,381	38,433	32,147
8	0602122A	02	TRACTOR HIP	5,683	6,406	7,804
9	0602211A	02	AVIATION TECHNOLOGY	39,406	47,780	34,295
10	0602270A	02	EW TECHNOLOGY	16,570	19,703	19,129
11	0602303A	02	MISSILE TECHNOLOGY	92,106	82,781	62,524
12	0602307A	02	ADVANCED WEAPONS TECHNOLOGY	14,794	24,495	21,139
13	0602308A	02	ADVANCED CONCEPTS AND SIMULATION	30,611	22,721	16,013
14	0602601A	02	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	125,893	114,108	64,883
15	0602618A	02	BALLISTICS TECHNOLOGY	57,537	54,889	49,163
16	0602622A	02	CHEMICAL, SMOKE AND EQUIPMENT DEFEATING TECHNOLOGY	21,851	7,585	2,519
17	0602623A	02	JOINT SERVICE SMALL ARMS PROGRAM	5,683	11,273	5,703
18	0602624A	02	WEAPONS AND MUNITIONS TECHNOLOGY	75,714	102,442	37,824
19	0602705A	02	ELECTRONICS AND ELECTRONIC DEVICES	77,267	102,768	39,554
20	0602709A	02	NIGHT VISION TECHNOLOGY	21,634	26,406	23,823
21	0602712A	02	COUNTERMINE SYSTEMS	26,170	26,279	19,293
22	0602716A	02	HUMAN FACTORS ENGINEERING TECHNOLOGY	24,056	20,656	17,482
23	0602720A	02	ENVIRONMENTAL QUALITY TECHNOLOGY	31,007	22,369	16,417
24	0602782A	02	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	18,223	27,416	21,787
25	0602783A	02	COMPUTER AND SOFTWARE TECHNOLOGY	4,031	3,862	3,590
26	0602784A	02	MILITARY ENGINEERING TECHNOLOGY	51,885	52,500	47,046
27	0602785A	02	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	15,143	14,846	15,207
28	0602786A	02	LOGISTICS TECHNOLOGY	49,642	54,051	21,707
29	0602787A	02	MEDICAL TECHNOLOGY	175,543	183,102	74,694
	Total: Applied Research			1,046,041	1,117,659	671,302

Line No.	Program Element Number	Act	Item	Thousands of Dollars FY 2004	FY 2005	FY 2006
			Advanced technology development			
30	0603001A	03	WARFIGHTER ADVANCED TECHNOLOGY	65,848	77,022	63,754
31	0603002A	03	MEDICAL ADVANCED TECHNOLOGY	214,453	299,561	45,160
32	0603003A	03	AVIATION ADVANCED TECHNOLOGY	83,686	96,465	48,318
33	0603004A	03	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	52,927	83,337	74,927
34	0603005A	03	COMBAT VEHICLE AND AUTOMOTIVE ADVANCED TECHNOLOGY	266,576	279,260	142,866
35	0603006A	03	COMMAND, CONTROL, COMMUNICATIONS ADVANCED TECHNOLO	11,168	9,544	12,066
36	0603007A	03	MANPOWER, PERSONNEL AND TRAINING ADVANCED TECHNOLO	8,787	8,070	6,783
37	0603008A	03	ELECTRONIC WARFARE ADVANCED TECHNOLOGY	58,281	57,662	45,322
38	0603009A	03	TRACTOR HIKE	7,570	7,723	8,777
39	0603015A	03	NEXT GENERATION TRAINING & SIMULATION SYSTEMS	15,421	26,900	19,982
40	0603020A	03	TRACTOR ROSE	4,096	4,537	4,956
41	0603103A	03	EXPLOSIVE DEMILITARIZATION TECHNOLOGY	24,468	18,405	9,865
42	0603105A	03	MILITARY HIV RESEARCH	13,847	13,552	6,842
43	0603125A	03	COMBATING TERRORISM, TECHNOLOGY DEVELOPMENT FOR	8,480	8,034	6,306
44	0603238A	03	GLOBAL SURVEILLANCE/AIR DEFENSE/PRECISION STRIKE T	12,317	10,284	12,111
45	0603270A	03	EW TECHNOLOGY	24,979	21,357	16,801
46	0603313A	03	MISSILE AND ROCKET ADVANCED TECHNOLOGY	119,301	115,332	70,066
47	0603322A	03	TRACTOR CAGE	7,386	12,776	15,406
48	0603606A	03	LANDMINE WARFARE AND BARRIER ADVANCED TECHNOLOGY	29,215	33,621	25,327
49	0603607A	03	JOINT SERVICE SMALL ARMS PROGRAM	9,431	9,675	6,581
50	0603654A	03	LINE-OF-SIGHT TECHNOLOGY DEMONSTRATION	8,607	0	0
51	0603710A	03	NIGHT VISION ADVANCED TECHNOLOGY	82,800	102,047	51,761
52	0603728A	03	ENVIRONMENTAL QUALITY TECHNOLOGY DEMONSTRATIONS	20,155	17,933	12,606
53	0603734A	03	MILITARY ENGINEERING ADVANCED TECHNOLOGY	12,909	25,657	7,301
54	0603772A	03	ADVANCED TACTICAL COMPUTER SCIENCE AND SENSOR TECH	24,358	46,313	42,475
	Total:		Advanced technology development	1,187,066	1,385,067	756,359
			Advanced Component Development and Prototypes			
55	0603024A	04	UNIQUE ITEM IDENTIFICATION (UID)	0	0	1,500
56	0603305A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION	101,208	112,069	14,573
57	0603308A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION (DEM/VAL)	33,735	32,131	9,284
58	0603327A	04	AIR AND MISSILE DEFENSE SYSTEMS ENGINEERING	115,342	109,217	83,063
59	0603619A	04	LANDMINE WARFARE AND BARRIER - ADV DEV	34,713	15,843	0
60	0603627A	04	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ADV DEV	9,634	9,342	5,733

Line No.	Program Element Number	Act	Item	Thousands of Dollars FY 2004	FY 2005	FY 2006
61	0603639A	04	TANK AND MEDIUM CALIBER AMMUNITION	24,737	26,674	0
62	0603653A	04	ADVANCED TANK ARMAMENT SYSTEM (ATAS)	57,621	49,712	26,712
63	0603747A	04	SOLDIER SUPPORT AND SURVIVABILITY	13,133	13,234	3,393
64	0603766A	04	TACTICAL SUPPORT DEVELOPMENT - ADV DEV (TIARA)	16,024	15,218	18,907
65	0603774A	04	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT	6,651	17,052	6,885
66	0603779A	04	ENVIRONMENTAL QUALITY TECHNOLOGY DEM/VAL	38,461	41,651	5,166
67	0603782A	04	WARFIGHTER INFORMATION NETWORK-TACTICAL - DEM/VAL	77,275	95,321	131,081
68	0603790A	04	NATO RESEARCH AND DEVELOPMENT	2,608	4,600	4,902
69	0603801A	04	AVIATION - ADV DEV	13,583	16,017	6,249
70	0603802A	04	WEAPONS AND MUNITIONS - ADV DEV	29,906	8,321	0
71	0603804A	04	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	12,212	15,993	13,375
72	0603805A	04	COMBAT SERVICE SUPPORT CONTROL SYSTEM EVALUATION A	8,151	6,138	10,659
73	0603807A	04	MEDICAL SYSTEMS - ADV DEV	12,715	20,286	10,134
74	0603827A	04	SOLDIER SYSTEMS - ADVANCED DEVELOPMENT	0	0	10,595
75	0603850A	04	INTEGRATED BROADCAST SERVICE (JMIP/DISTP)	1,968	4,294	2,762
76	0603856A	04	SCAMP BLOCK II	27,716	9,798	0
77	0603869A	04	MEADS CONCEPTS - DEM/VAL	236,823	251,414	0
	Total:		Advanced Component Development and Prototypes	874,216	874,325	364,973
			System Development and Demonstration			
78	0604201A	05	AIRCRAFT AVIONICS	45,499	79,356	23,451
79	0604220A	05	ARMED, DEPLOYABLE OH-58D	0	43,366	13,964
80	0604223A	05	COMANCHE	1,030,510	0	0
81	0604270A	05	EW DEVELOPMENT	31,715	16,515	32,179
82	0604280A	05	JOINT TACTICAL RADIO SYSTEM	128,611	117,259	156,665
83	0604321A	05	ALL SOURCE ANALYSIS SYSTEM	19,258	6,605	7,973
84	0604328A	05	TRACTOR CAGE	15,482	13,576	16,099
85	0604329A	05	COMMON MISSILE	90,413	112,185	0
86	0604601A	05	INFANTRY SUPPORT WEAPONS	27,344	33,712	34,627
87	0604604A	05	MEDIUM TACTICAL VEHICLES	4,169	14,046	1,886
88	0604609A	05	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ENG DEV	11,548	3,639	0
89	0604611A	05	JAVELIN	913	905	0
90	0604622A	05	FAMILY OF HEAVY TACTICAL VEHICLES	16,282	19,631	3,415
91	0604633A	05	AIR TRAFFIC CONTROL	2,402	2,012	4,508
92	0604642A	05	LIGHT TACTICAL WHEELED VEHICLES	17,377	9,587	0
93	0604645A	05	ARMORED SYSTEMS MODERNIZATION (ASM)-ENG. DEV.	1,373,156	2,268,236	3,065,629

Line No.	Program Element Number	Act	Item	Thousands of Dollars FY 2004	FY 2005	FY 2006
94	0604646A	05	NON LINE OF SIGHT LAUNCH SYSTEM	0	55,794	231,554
95	0604647A	05	NON LINE OF SIGHT CANNON	251,344	476,736	107,587
96	0604710A	05	NIGHT VISION SYSTEMS - ENG DEV	37,452	26,119	26,449
97	0604713A	05	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	95,484	98,445	3,383
98	0604715A	05	NON-SYSTEM TRAINING DEVICES - ENG DEV	68,381	49,615	61,090
99	0604716A	05	TERRAIN INFORMATION - ENG DEV	6,662	3,152	0
100	0604726A	05	INTEGRATED METEOROLOGICAL SUPPORT SYSTEM	3,160	2,450	0
101	0604741A	05	AIR DEFENSE COMMAND, CONTROL AND INTEL - ENG	27,974	26,343	29,012
102	0604742A	05	CONSTRUCTIVE SIMULATION SYSTEMS DEVELOPMENT	16,227	41,153	40,572
103	0604746A	05	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	10,918	8,748	54
104	0604760A	05	DISTRIBUTIVE INTERACTIVE SIMULATIONS (DIS) - ENGIN	24,883	25,477	22,057
105	0604766A	05	TACTICAL EXPLOITATION SYSTEM/DCGS (TIARA)	25,108	21,505	0
106	0604768A	05	BRILLIANT ANTI-ARMOR SUBMUNITION (BAT)	9,550	1,748	0
107	0604770A	05	JOINT SURVEILLANCE/TARGET ATTACK RADAR SYSTEM	4,492	0	0
108	0604778A	05	POSITIONING SYSTEMS DEVELOPMENT (SPACE)	1,503	1,962	0
109	0604780A	05	COMBINED ARMS TACTICAL TRAINER (CATT)	3,817	18,316	37,471
110	0604783A	05	JOINT NETWORK MANAGEMENT SYSTEM	9,011	10,279	5,092
111	0604801A	05	AVIATION - ENG DEV	3,227	3,239	0
112	0604802A	05	WEAPONS AND MUNITIONS - ENG DEV	151,558	154,356	87,034
113	0604804A	05	LOGISTICS AND ENGINEER EQUIPMENT - ENG DEV	84,398	90,517	13,353
114	0604805A	05	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ENG DEV	209,197	218,402	393,062
115	0604807A	05	MEDICAL MATERIEL/MEDICAL BIOLOGICAL DEFENSE EQUIPM	21,820	19,325	5,627
116	0604808A	05	LANDMINE WARFARE/BARRIER - ENG DEV	92,808	57,116	80,560
117	0604814A	05	ARTILLERY MUNITIONS - EMD	118,323	133,167	113,368
118	0604817A	05	COMBAT IDENTIFICATION	11,402	12,069	2,973
119	0604818A	05	ARMY TACTICAL COMMAND & CONTROL HARDWARE & SOFTWAR	97,612	64,811	66,980
120	0604819A	05	LOSAT	29,417	21,744	0
121	0604820A	05	RADAR DEVELOPMENT	0	5,851	5,080
122	0604822A	05	GENERAL FUND ENTERPRISE BUSINESS SYSTEM (GFEBS)	0	0	71,119
123	0604823A	05	FIREFINDER	25,883	21,764	46,061
124	0604827A	05	SOLDIER SYSTEMS - WARRIOR DEM/VAL	0	0	57,818
125	0604854A	05	ARTILLERY SYSTEMS - EMD	31,155	12,022	5,476
126	0604865A	05	PATRIOT PAC-3 THEATER MISSILE DEFENSE ACQ - EMD	151,318	61,482	0
127	0604869A	05	PATRIOT/MEADS COMBINED AGGREGATE PROGRAM (CAP)	0	0	288,785
128	0605013A	05	INFORMATION TECHNOLOGY DEVELOPMENT	60,983	95,836	63,662
	Total:		System Development and Demonstration	4,499,746	4,580,173	5,225,675

Line No.	Program Element Number	Act	Item	Thousands of Dollars FY 2004	FY 2005	FY 2006
	Management support					
129	0604256A	06	THREAT SIMULATOR DEVELOPMENT	25,008	29,694	23,796
130	0604258A	06	TARGET SYSTEMS DEVELOPMENT	17,153	13,370	10,855
131	0604759A	06	MAJOR T&E INVESTMENT	76,732	58,988	64,498
132	0605103A	06	RAND ARROYO CENTER	28,161	21,854	23,800
133	0605301A	06	ARMY KWAJALEIN ATOLL	177,197	139,939	154,535
134	0605326A	06	CONCEPTS EXPERIMENTATION	39,175	24,190	31,653
135	0605502A	06	SMALL BUSINESS INNOVATIVE RESEARCH	0	261,896	0
136	0605601A	06	ARMY TEST RANGES AND FACILITIES	233,336	191,688	369,943
137	0605602A	06	ARMY TECHNICAL TEST INSTRUMENTATION AND TARGETS	72,595	60,142	62,687
138	0605604A	06	SURVIVABILITY/LETHALITY ANALYSIS	53,408	47,543	38,306
139	0605605A	06	DOD HIGH ENERGY LASER TEST FACILITY	23,347	15,098	17,688
140	0605606A	06	AIRCRAFT CERTIFICATION	3,826	3,419	2,748
141	0605702A	06	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	11,941	8,415	8,829
142	0605706A	06	MATERIEL SYSTEMS ANALYSIS	19,957	17,675	15,517
143	0605709A	06	EXPLOITATION OF FOREIGN ITEMS	4,421	4,672	4,710
144	0605712A	06	SUPPORT OF OPERATIONAL TESTING	85,477	72,284	75,993
145	0605716A	06	ARMY EVALUATION CENTER	59,362	61,212	57,305
146	0605718A	06	SIMULATION & MODELING FOR ACQ, RQTS, & TNG (SMART)	3,276	1,853	9,437
147	0605801A	06	PROGRAMWIDE ACTIVITIES	80,336	58,106	54,269
148	0605803A	06	TECHNICAL INFORMATION ACTIVITIES	53,742	27,534	32,237
149	0605805A	06	MUNITIONS STANDARDIZATION, EFFECTIVENESS & SAFETY	50,758	38,159	16,922
150	0605857A	06	ENVIRONMENTAL QUALITY TECHNOLOGY MGMT SUPPORT	6,098	4,336	4,014
151	0605898A	06	MANAGEMENT HEADQUARTERS (RESEARCH AND DEVELOPMENT)	15,078	11,842	12,908
	Total: Management support			1,140,384	1,173,909	1,092,650
	Operational system development					
152	0603778A	07	MLRS PRODUCT IMPROVEMENT PROGRAM	83,050	105,444	114,297
153	0603820A	07	WEAPONS CAPABILITY MODIFICATIONS UAV	0	0	0
154	0102419A	07	JOINT LAND ATTACK CRUISE MISSILES DEFENSE (JLENS)	57,803	79,316	106,420
155	0203610A	07	DOMESTIC PREPAREDNESS AGAINST WEAPONS OF MASS DEST	3,916	0	0
156	0203726A	07	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	28,308	17,269	16,064
157	0203735A	07	COMBAT VEHICLE IMPROVEMENT PROGRAMS	31,018	17,174	12,030

Line No.	Program Element Number	Act	Item	Thousands of Dollars FY 2004	FY 2005	FY 2006
158	0203740A	07	MANEUVER CONTROL SYSTEM	38,747	23,350	44,903
159	0203744A	07	AIRCRAFT MODIFICATIONS/PRODUCT IMPROVEMENT PROGRAM	273,381	242,628	409,103
160	0203752A	07	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	5,285	7,121	2,066
161	0203758A	07	DIGITIZATION	17,865	29,045	12,343
162	0203759A	07	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW (FBCB2	47,414	22,546	20,201
163	0203801A	07	MISSILE/AIR DEFENSE PRODUCT IMPROVEMENT PROGRAM	45,587	32,082	16,188
164	0203802A	07	OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS	1,050	4,659	23,560
165	0203806A	07	TRACTOR RUT	8,665	3,181	0
166	0203808A	07	TRACTOR CARD	9,060	8,644	6,797
167	0208010A	07	JOINT TACTICAL COMMUNICATIONS PROGRAM (TRI-TAC)	16,196	17,414	24,906
168	0208053A	07	JOINT TACTICAL GROUND SYSTEM	9,561	9,822	12,854
169	0208058A	07	JOINT HIGH SPEED VESSEL (JHSV)	0	0	3,261
170	0303028A	07	SECURITY AND INTELLIGENCE ACTIVITIES	15,712	14,398	2,992
171	0303140A	07	INFORMATION SYSTEMS SECURITY PROGRAM	20,291	28,618	22,903
172	0303141A	07	GLOBAL COMBAT SUPPORT SYSTEM	54,656	90,351	79,752
173	0303142A	07	SATCOM GROUND ENVIRONMENT (SPACE)	85,511	51,829	58,659
174	0303150A	07	WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM	16,762	18,459	13,647
175	0303158A	07	JOINT COMMAND AND CONTROL - ARMY	0	0	1,696
176	0305114A	07	TRAFFIC CONTROL, APPROACH AND LANDING SYSTEM-FY 19	935	0	0
177	0305204A	07	TACTICAL UNMANNED AERIAL VEHICLES	67,931	53,592	139,610
178	0305206A	07	AIRBORNE RECONNAISSANCE ADV DEVELOPMENT	4,651	8,111	5,398
179	0305208A	07	DISTRIBUTED COMMON GROUND/SURFACE SYSTEMS (JMIP)	36,995	53,911	91,587
180	0702239A	07	AVIONICS COMPONENT IMPROVEMENT PROGRAM	0	955	994
181	0708045A	07	END ITEM INDUSTRIAL PREPAREDNESS ACTIVITIES	84,980	88,120	68,505
182	0P0GMTOT	07	OTHER ARMY PROGRAMS	19,737	4,996	3,966
183	1001018A	07	NATO JOINT STARS	493	587	569
	Total:		Operational system development	1,085,560	1,033,622	1,315,271
				10,202,221	10,557,619	9,733,824

Total: RDT&E, Army

Table of Contents - RDT&E Volume I

Table of Contents - RDT&E Volume I

Table of Contents - RDT&E Volume I

Alphabetic Listing - RDT&E Volume I

Alphabetic Listing - RDT&E Volume I

Alphabetic Listing - RDT&E Volume I

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601101A - In-House Laboratory Independent Research

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		23040	23077	20542	21199	21730	22148	21753	21811
91A	ILIR-AMC	17676	17531	15268	15715	16070	16527	16144	16145
91C	ILIR-MED R&D CMD	4000	3891	3741	3886	4017	3963	4007	4046
91D	ILIR-CORPS OF ENGR	1364	1365	1217	1270	1309	1319	1256	1268
91E	ILIR-ARI	0	290	316	328	334	339	346	352

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 technical directors 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).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	23971	25052	25302
Current Budget (FY 2006/2007 PB)	23077	20542	21199
Total Adjustments	-894	-4510	-4103
Net of Program/Database Changes			
Congressional Program Reductions	-344		
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer	-550		
Adjustments to Budget Years		-4510	-4103

Change Summary Explanation:
FY06 - Funds realigned ($4510) to higher priority requirements.
FY07 - Funds realigned ($4103) to higher priority requirements.

Projects with no R-2A:

(FY05:$290; FY06: $316; FY07: $328) Army Research Institute, Project 91E: The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) provides the Army's basic research in personnel, training, and leader development to ensure that the human component of warfighting keeps pace with the equipment, weapons, and system changes envisioned for transformation to the Future Force. In FY05 focus on the ability of people to detect and react to changes in the digital environment, evaluate theories of situational judgment tests, and develop theory of consensus based measurement. In FY06, focus on conditional reasoning and performance in the context of decision-making. In FY07, focus on cognitive models of the emotional regulation of behavior.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
91A	ILIR-AMC	17676	17531	15268	15715	16070	16527	16144	16145

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 DoD 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 2004	FY 2005	FY 2006	FY 2007
- Edgewood Chemical Biological Center - In FY04, conducted basic research in chemistry and biology having potential application to meet Army requirements in chemical and biological defense (CBD) as well as biotechnology. Specific accomplishments having potential for CBD applications include the construction of antibody-based nanosensors used with nuclear magnetic resonance (NMR) to detect ricin, and the use of metabonomics (measurement of the metabolic response of an organism to a stimulus) in combination with NMR as a means to identify a brain biomarker for chemical agent exposure. Accomplishments in biotechnology include the innovative construction of hybridoma cells (hybrid cells formed from cancerous and normal cells) having enhanced antibody production capacities and the scale-up of a recombinant protein production and downstream processing capability for the production of bacteriorhodopsin, a light absorbing protein having potential application in biologically-derived electronic and photonic materials. In FY05, solicit new and continuing basic research proposals and make awards based on scientific merit, innovation, and military relevance. Expected efforts include: continue investigation on metabonomics to further enhance antibody production; conduct principal component analysis to better identify biomarkers of chemical agent exposure. In FY06, will solicit new and continuing basic research efforts focused on fundamental questions pertaining to CBD and applied biotechnology that address Army requirements. Anticipated efforts: will investigate and establish molecular fingerprints for detection and forensic sub-tying of protein toxins; characterize protein toxin interactions with ligand molecules by NMR to develop better detection of and countermeasures for these threats. In FY07, will solicit new and continuing basic research efforts focused on fundamental questions pertaining to CBD and applied biotechnology that address Army requirements.	2176	1920	1635	1704

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Armaments RDEC - In FY04 conducted basic research in: synthesis of new energetic formulations for higher output with lower vulnerability; multi-sensor fusion for smart munitions; nanotechnology enhanced energy density capacitance; and synergistic directed energy effects. In FY05, conduct basic research in nano-scale materials and carbon nano-tubes, novel uses of acoustic sensors, new methods for synthesis of high energy materials, E-field sensors for area denial munitions, angular and position measurement systems, advanced target acquisition techniques, and advanced insensitive munitions. In FY06, will conduct basic research in advanced warheads, micro-electrical mechanical system technology, insensitive munition technology, lightweight composite materials, advanced propellants, more powerful energetic formulations and advanced fuzing technology. In FY07, will conduct basic research in nanoparticle explosives, advanced projectile guidance and control, new advanced smart munitions, high power microwave technology, non-lethal effects, and high energy composite materials.	3093	3152	2745	2812
- Tank-automotive RDEC - In FY04, tested and evaluated fuzzy logic and neural net control strategies and terrain models for unmanned ground vehicle perception; continued maturation and testing of engine combustion models and materials for laser eye protection; modeled and tested mechanisms for cooling vehicle electronics; and performed investigations into high speed ballistic impact imaging and modeling. In FY05, fabricate and test real-time four-Stokes parameter optical apparatus for robotic vehicle perception and signature measurement; formulate mathematical models of diesel engine flame propagation in terms of multi-fuel performance parameters; compare theoretical and experimental liquid heat capillary tube thermal transfer performance characteristics for passive, low signature cooling of military electronics; formulate intelligent agent architectures for swarming ground robot behaviors. In FY06 will formulate evolutionary computing algorithms for adaptive path planning and navigation; develop in-situ combustion chamber temperature and pressure sensors to validate high performance engine thermodynamic combustion models; solve multi-body equations of motion for forward and inverse ground vehicle dynamic models. In FY07, will develop reinforcement learning algorithms and compare performance with bio-inspired robot behaviors; compute liquid heat pipe (LHP) heat transfer coefficients for ground vehicle environments and compare with NASA zero-gravity spacecraft data; model advanced ground propulsion phenomena in support of Army's Future Combat Systems (FCS) requirements.	2011	2214	1928	1974

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Natick Soldier Center – In FY04, modeled new nanocomposites for use in improved ballistic/optical materials; examined layered nanomaterials for potential soldier applications; determined kinetics of microbial inactivation using high pressure in model foods; researched influence of optical properties of textiles on thermal/signature management; modeled bluff body motion and measured unsteady aerodynamic characteristics; and quantified nanoparticle-polymer interaction in nanocomposites using electron spin resonance. In FY05, extend model on inactivation of pressure resistant bacterial spores; research behavioral strategies for overcoming claustro-intolerance in warfighters; investigate interaction between movement in complex environments and cognitive processing of information; and examine self-assembled phage based fibers (collaboration with Institute for Collaborative Biotechnologies). In FY06, will confirm essential features of mathematical representation of permeation kinetics in model foods; explore novel structures and biological templates for textile-based, soldier-borne sensors; and examine new approaches to materials for soldier personal protection via self-assembled nanostructures. In FY07, will examine means for coupling biorecognition elements to polymers for advanced sensing; and examine fundamental mechanisms that can interrupt degradation mechanisms in model foods for shelf-stable rations.	1442	1570	1407	1484

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Aviation and Missile RDEC Missile Efforts - In FY04, transitioned secure communications link based on chaotic waveform to Unmanned Ground Vehicle Project Office. Transitioned advanced Computational Fluid Dynamics models and designs into future hypersonic missile programs. Transitioned protective coatings based on Photonic Band-Gap materials to applied technology programs for missile sensor protection from laser threats. Constructed, tested, and evaluated a prototype field demonstrator of a cost-effective three dimensional display. Established a laboratory for the evaluation of ultra-short (femtosecond) pulsed laser radiation. In FY05, evaluate the propagation characteristics of ultra-short pulsed laser radiation in realistic atmosphere. Analyze and quantify the damage characteristics of ultra-short pulse laser radiation to materials common to missile, aircraft, and Unmanned Aerial Vehicles (UAV) structure and components. Investigate techniques to predict and engineer the optical properties of materials to be used for laser-based optical communications and optical information technology. Test and evaluate flat panel display technology capable of providing full frame rate, full resolution stereo viewing to the user and transfer this technology to advanced research programs. In FY06, will test and evaluate at the laboratory breadboard level the fundamental operations of a quantum computer. Will perform the necessary experiments and/or analysis to allow the transition of ultra-short pulse laser technology to appropriate applied technology programs. In FY07, will demonstrate new concepts in specific focus areas of ultra-short pulsed lasers, nano technology, complex chaotic systems, quantum computing and photonic bandgap structures for applications in RF devices, sensor protection and other missile systems.	3447	3055	2661	2728
- Aviation and Missile RDEC Aviation Efforts - In FY04, completed the investigation of active on-blade control for a swashplate-less rotor concept. Conducted the synthetic jet test to reduce adverse fuselage aerodynamics allowing for increased speed and range. In FY05, perform research to achieve robust control architecture for UAV missions. Conduct research to measure boundary layer properties in separated-flow regions to construct new turbulence models. Generate new high order dissipation schemes to reduce the spurious vortex dissipation in the OVERFLOW code. In FY 06, will analyze the particle image velocimetry (PIV) measured data, and develop new turbulence model based on the PIV measurement of boundary layer properties in separated-flow regions. Will generate the background oriented stereo Schleiren technique. In FY07, will generate unstructured grid algorithms for rotorcraft/UAV aerodynamics. Will investigate the modeling and suppression of rotorcraft disturbance response.	2836	2895	2519	2582

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Communications-Electronics RDEC - In FY04, studied and monitored Explosive Related Chemicals (ERC) levels in surface soils over time and correlated air flux to surface soil ERC concentrations. Studied the basic solvent/ion interactions to determine optimum composition for new Lithium Ion Batteries. Investigated a software approach to convert natural language to eXtensible Mark-up Language (XML) for C2 applications. Investigated an improved encryption algorithm for communications networks. In FY05, investigate models for fused sensors and improved automatic/aided target recognition algorithms. Characterize membrane-based oxygen-enriched combustion of liquid hydrocarbon fuels. Investigate an entropy based network architecture for improved communication, conduct basic research in highly efficient small antennas. Investigate the enhancement of electromagnetic signals utilizing surface plasmonic properties. In FY06, will complete analysis of ultraviolet-C band muzzle flash intensity and detection range for counter sniper applications. Will perform research enabling high bandwidth, high-efficiency small antennas at lower frequencies with reduced co-site interference. Will formulate and investigate new high-energy cathode materials for advanced lithium batteries. In FY07, will investigate new radio frequency absorption material for warfighters body-wearable vest. Will explore techniques for more reliable (terahertz band) communication and for improving information encoding in noisy channels. Will investigate polymer and polymer blends with high breakdown voltage characteristics for electrochemical systems. Will investigate the feasibility of using modified Bayesian Belief Networks to express essential knowledge in order to perform selected core data fusion tasks for Level 2 data fusion.	2671	2725	2373	2431
Totals	17676	17531	15268	15715

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
91C	ILIR-MED R&D CMD	4000	3891	3741	3886	4017	3963	4007	4046

A. Mission Description and Budget Item Justification: This project addresses medical and force protection research needs at the six Medical Research and Materiel Command laboratories: the U.S. Army Aeromedical Research Laboratory (USAARL), the U.S. Army Institute of Surgical Research (USAISR), the U.S. Army Research Institute of Environmental Medicine (USARIEM), the U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), and the Walter Reed Army Institute of Research (WRAIR). 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 WRAIR, Silver Spring, MD; USAMRICD, Aberdeen Proving Ground, MD; USAMRIID, Fort Detrick, MD; USARIEM, Natick, MA; USAISR, Fort Sam Houston, TX; and USAARL Fort Rucker, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, published study showing soldiers experiencing exertional heat injury (EHI) had high levels of expression of interferon (IFN)-inducible genes in their peripheral blood mononuclear cells, suggesting that (IFN)-gamma may play a role. Produced human and animal microarrays for analysis of gene expression, emphasizing transcriptome in circulating white blood cells, which may predict success of appropriate resuscitation following traumatic injury. Identified steps that vaccine-induced antibodies must block to prevent malaria parasite invasion into new red blood cells. Validated a method to measure the adverse effects of glare on soldier visual performance under low light conditions. Established analytical methods for diagnosing sulfur mustard and nerve agent soman exposure. In FY05, conduct gene chip studies to characterize the human gene expression response to dehydration. Research the genetic response to hemorrhagic shock and screen for cytoprotective agents for use in resuscitation. Assess acute sensorineural hearing loss and vestibular pathology in deployed soldiers. Investigate the suppression of Ebola virus by ribonucleic acid interference. Evaluate the role of inflammation in sulfur mustard toxicity. In FY06, will determine whether IFN-gamma is associated with incidence/severity of EHI; evaluate blood dilution and lower core body temperature in clotting dysfunction during hemorrhage; research novel infectious disease and bio/chem threat treatments, diagnostics, and delivery systems; study visuomotor markers of cognitive impairment in UAV operators; construct/analyze genetic footprints of Alphaviruses and Filoviruses; and compare phosgene induced respiratory and inhaled chemical warfare agent injury. In FY07, will conduct studies on the human cellular response to environmental stress; explore new concepts for hemorrhage control and treatments; and identify potential biomarkers of bio-agent infection.	4000	3891	3741	3886
Totals	4000	3891	3741	3886

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
91D	ILIR-CORPS OF ENGR	1364	1365	1217	1270	1309	1319	1256	1268

A. Mission Description and Budget Item Justification: This project supports 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 DoD Basic Research Plan (BRP). The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, executes the project work.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Battlespace Environment/Military Engineering/Environmental Quality and Installations - In FY04, investigated response of human cells to environmental contamination using novel bio-chemical chemistry procedures to potentially develop cell-based analyses for on-site sensing of environmental contamination. Evaluated electrokinetics as a means for rapidly strengthening soils. Explored applications of laws of electromagnetic energy transfer for use in characterizing media reflections. Investigated neural nets as a tool for predicting geologic fracture properties from imagery to enhance weapons effects and penetrability. In FY05, study differential temperature effects on the thermophysical properties of bulk and vicinal water in soils. Conduct research on soil electromagnetic models to be incorporated into state-of-ground models supporting terrain reasoning and awareness. In FY06, will investigate radar signal reflectance to remotely map soil moisture and strength for mobility and landing site assessments for aircraft. Will investigate new, innovative acoustic processing methods that will allow soldiers to locate targets in urban areas. In FY07, will investigate hydrogels for innovative applications in environmental monitoring and engineering, and nanomaterials synthesis. Will study and validate a discrete element model for simulating the mechanical properties of dry soil.	1364	1365	1217	1270
Totals	1364	1365	1217	1270

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601102A - DEFENSE RESEARCH SCIENCES

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	151503	163443	137898	142898	146370	147979	149267	150374
305	ATR RESEARCH	1174	1214	1262	1312	1337	1353	1365	1375
31B	INFRARED OPTICS RSCH	2230	2318	2415	2514	2563	2599	2622	2640
52C	MAPPING & REMOTE SENS	2333	2388	2469	2562	2624	2659	2682	2702
53A	BATTLEFIELD ENV & SIG	2562	2798	2895	2961	2943	3019	3044	3067
74A	HUMAN ENGINEERING	2621	2748	2858	2972	3010	3051	3078	3101
74F	PERS PERF & TRAINING	2595	2588	2710	2772	2870	2872	2895	2917
F20	ADV PROPULSION RSCH	1881	2041	2133	2218	2240	2232	2251	2267
F22	RSCH IN VEH MOBILITY	481	491	508	528	541	549	553	558
H42	MATERIALS & MECHANICS	1942	2040	2120	2206	2235	2264	2283	2301
H43	RESEARCH IN BALLISTICS	5923	5962	7101	7324	7461	7411	7475	7531
H44	ADV SENSORS RESEARCH	3791	3844	4000	4162	4214	4281	4318	4349
H45	AIR MOBILITY	2072	2073	2133	2218	2282	2314	2333	2352
H47	APPLIED PHYSICS RSCH	2520	2649	2781	2868	2905	2954	2980	3002
H48	BATTLESPACE INFO & COMM RSC	5241	5526	5735	5957	6074	6086	6141	6188
H52	EQUIP FOR THE SOLDIER	994	1058	1101	1141	1152	1164	1173	1182
H57	SCI PROB W/ MIL APPLIC	52881	53975	61380	63579	65534	66221	66792	67283
H66	ADV STRUCTURES RSCH	1425	1518	1588	1651	1661	1681	1696	1708
H67	ENVIRONMENTAL RESEARCH	1357	1484	828	825	810	893	901	908
H68	PROC POLLUT ABMT TECH	371	364	381	395	412	418	421	425
S04	MIL POLLUTANT/HLTH HAZ	624	616	640	664	689	701	706	711
S13	SCI BS/MED RSH INF DIS	9400	9691	10098	10492	10710	10854	10948	11028
S14	SCI BS/CBT CAS CARE RS	4098	4143	4324	4495	4613	4677	4718	4751
S15	SCI BS/ARMY OP MED RSH	5612	5786	6041	6273	6404	6490	6547	6593
S19	T-MED/SOLDIER STATUS	640	644	689	716	735	750	766	781
T14	BASIC RESEARCH INITIATIVES - AMC (CA)	26094	31059	0	0	0	0	0	0
T22	SOIL & ROCK MECH	1910	1971	2031	2110	2157	2186	2205	2220

T23	BASIC RES MIL CONST	1602	1608	1666	1735	1787	1810	1827	1839
T24	SNOW/ICE & FROZEN SOIL	1189	1292	1361	1413	1412	1425	1438	1448
T25	ENVIRONMENTAL RES-COE	4501	4473	4650	4835	4995	5065	5109	5147
T59	PREDICTION OF LAND-ATMOSPHERE INTERACTIONS	1439	1343	0	0	0	0	0	0
T60	BRAIN IMAGING RESEARCH	0	3738	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element fosters fundamental scientific knowledge and contributes to the sustainment of U.S. Army scientific and technological superiority in land war fighting 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 the four primary contributors: 1) the Army Research, Development and Engineering Command (RDECOM); 2) the U.S. Army Engineer Research and Development Center (ERDC); 3) the Army Medical Research and Materiel Command laboratories; and 4) the Army Research Institute for Behavioral and Social Sciences (ARI). The basic research program is coordinated with the other Services via the Joint Directors of Laboratories panels, the Defense Basic Research Technology Area Review and Assessment (TARA) process 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 the technologies that can significantly improve joint war fighting capabilities. The projects in this Program Element involve basic research efforts directed toward providing fundamental knowledge for 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 DoD Basic Research Plan (BRP). Work in this PE is managed by: the U.S. Army Research Laboratory (ARL); the U.S. Army Aviation and Missile Research, Development and Engineering Center (AMRDEC); the U.S. Army Natick Soldier Center (NSC), the Medical Research and Materiel Command (MRMC), the U.S. Army Engineer Research and Development Center (ERDC), and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	131206	141023	143310
Current Budget (FY 2006/2007 PB)	163443	137898	142898
Total Adjustments	32237	-3125	-412
Net of Program/Database Changes			
Congressional Program Reductions	-2371		
Congressional Rescissions			
Congressional Increases	37700		
Reprogrammings			
SBIR/STTR Transfer	-3092		
Adjustments to Budget Years		-3125	-412

Change Summary Explanation:

Fourteen FY05 Congressional Adds totaling $37700 were added to this PE.

FY05 Congressional Adds with no R-2As:
($1918) Advanced Carbon Nanotechnology Program, Project T14: The purpose of this one year Congressional add is to fund a basic research program in carbon nanotechnology. No additional funds are required to complete this project.

($959) Advanced Deployable Nano-Sensors, Project T14: The purpose of this one year Congressional add is to fund basic research in nano-sensing capabilities. No additional funds are required to complete this project.

($2685) Advanced Research and Technology Initiative, Project T14: The purpose of this one year Congressional add is to fund basic research at the University of North Texas. No additional funds are required to complete this project.

($1438) Army Knowledge Management Fusion Center, Project T14: The purpose of this one year Congressional add is to fund basic research on data

fusion issues. No additional funding is required to complete this project.

($959) Bioterrorists Agents in Military Drinking Water Systems, Project T14: The purpose of this one year Congressional add is to fund basic research in biofilms at Montana State University to identify terrorist agents in drinking water. No additional funds are required to complete this project.

($3738) Brain Imaging Research, Project T60: The purpose of this one year Congressional add is to fund basic research in brain imaging. No additional funding is required to complete this project.

($1918) Center for Advanced Research and Technology (CART), Project T14: The purpose of this one year Congressional add is to fund basic research in nanometrology laboratory development to maximize the effectiveness of a high-resolution analytical transmission electron microscope. No additional funds are required to complete this project.

($2877) Desert Terrain Analysis for Enhancing Military Operations, Project T14: The purpose of this one year Congressional add is to fund research on the impacts of Army combat vehicle training on desert ecosystems. No additional funding is required to complete this project.

($1726) Functionally Integrated Reactive Surfaces Technologies (FIRST) Program, Project T14: The purpose of this one year Congressional add is to fund basic research in functionally integrated reactive surfaces. No additional funding is required to complete this project.

($2014) Optical Technologies Research, Project T14: The purpose of this one year Congressional add is to continue research supporting growth, processing, and device analysis of semiconductor materials for sensor, display and laser applications. No additional funding is required to complete this project.

($9589) Perpetually Assailable and Secure Information Systems Research, Training and Education (PASIS), Project T14: The purpose of this one year Congressional add is to provide funding to the Center for Perpetually Available and Secure Information Systems at Carnegie Mellon University investigating the availability and security of information systems. No additional funding is required to complete this project.

($1343) Prediction of Land-Atmosphere Interactions, Project T59: The purpose of this one year congressional add is to examine new techniques for measuring ground conditions from remote sensors and assimilating these data with model predictions for terrain state. No additional funding is required to complete this project.

($3357) Prometheus Spectrometer, Project T14: The purpose of this one year Congressional add is to fund basic research on the Prometheus Spectrometer. No additional funding is required to complete this project.

($1630) Technology Commercialization and Management Network, Project T14: The purpose of this one year Congressional add is to fund research on

an integrated technology transfer network and service management center.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
305	ATR RESEARCH	1174	1214	1262	1312	1337	1353	1365	1375

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. It is increasingly desirable to have Army systems that can act independently of the human operator to detect and track 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 will utilize 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 radar (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 DoD Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Investigate new algorithms to improve unaided target detection and identification. In FY04, devised new models for clutter to improve target detection performance, investigated new methods for feature extraction in target identification, expanded ATR training data by combining synthetic data with real FLIR data, investigated the use of hyperspectral imagery (HSI) for false-alarm reduction, paint identification, mine detection, netted and unnetted target detection, and acquired high resolution HSI for target classification. In FY05, devise detection and tracking algorithms based on FLIR video, incorporate other sensors to complement single sensor ATR algorithms, investigate new methods of feature extraction and classification algorithms, and study the use of polarization to detect water and man-made objects for robotic autonomous mobility. In FY06, will devise false alarm reduction and multiple hypotheses tracking algorithms for FLIR video, study the difference between synthetic and real imagery in the context of machine learning, and investigate new algorithm concepts and methods for target classification and false alarm reduction. In FY07, will 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 capabilities, and investigate more efficient and effective HSI algorithms for target detection and classification.	1174	1214	1262	1312
Totals	1174	1214	1262	1312

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
31B	INFRARED OPTICS RSCH	2230	2318	2415	2514	2563	2599	2622	2640

A. Mission Description and Budget Item Justification: This project supports Army research in materials and devices for active and passive infrared (IR) imaging systems. The impact of this research is to generate new technologies to obtain unprecedented awareness of the battlefield and to continue to "own the night." 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 are needed. Research is focused on material growth, detector and laser design, and processing for large area multicolor IR FPAs and interband cascade lasers. The main efforts are directed towards novel materials for detectors and lasers and to investigate semiconductor energy band-gap engineered structures 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 waveguide structures to enable reconfigurable IR waveguide properties. Customized III-V IR 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 with 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 DoD Basic Research Plan (BRP). Work is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- The objective of this project is to support the Army's research in materials and devices for active and passive infrared (IR) imaging systems. In FY04, achieved quality growth of antimony-based compound semiconductor materials by Molecular Beam Epitaxy (MBE) and paved the way for producing devices with state-of-the-art performance. Achieved theoretical understanding of these complex materials as a precursor for experimentally accomplishing goals in performance. Validated performance for medium wavelength IR detectors made of antimony-based semiconductors. With the aid of e-beam-lithography nanofabrication, designed, modeled and fabricated IR waveguides incorporating photonic crystal structures and MEMs reconfigurability. In FY05, evaluate IR FPAs made of superlattice material required for robust operation of the arrays. Improve the thermal performance of the IR cascade lasers for continuous wave operation at room temperature. Experimental results will guide the next iteration of design and fabrication of photonic-crystal waveguides. In FY06, will evaluate both long wavelength IR and medium wavelength IR FPAs. In FY07, will assess high power IR lasers for IR countermeasure and chemical/bio sensing applications. Will apply dynamic IR photonic-crystal waveguides to the control of RF signals.	2230	2318	2415	2514
Totals	2230	2318	2415	2514

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
52C	MAPPING & REMOTE SENS	2333	2388	2469	2562	2624	2659	2682	2702

A. Mission Description and Budget Item Justification: Basic research in topographic sciences focuses on increasing knowledge of the terrain through improved generation, management, analysis/reasoning, and modeling of geospatial data, including 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; to extract and attribute 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 investigates new methods of exploiting terrain and environmental data to improves 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 PE 0602784A Project 855, Mapping and Remote Sensing. The cited work is consistent with the DoD Basic Research Plan (BRP), the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, performs this work.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Sensor Phenomenology - In FY04, integrated band resolution and neural network algorithms for hyperspectral image classification. Modeled soil type, soil compaction and moisture effects on terrain signatures. In FY05, conduct multi-image manipulation experiments as well as contrast and special feature manipulation experiments. Will compare lineation patterns between panchromatic and hyperspectral imagery. In FY06, will research capability of new micro and nano sensors to characterize battlespace environment features. In FY07, will research exploitation of multiple types of sensors to characterize critical battlespace environment features. Active and Passive Fluorescence for Remote Sensing - In FY04, enhanced capabilities for identifying biological hazards. Designed polymers/sensor configuration and synthesize polymers using various fluorophores. In FY05, experiment with prototype capabilities for identifying biological hazards in water and test polymer(s) in soil and water for photon recovery and target selectivity. Will experiment with fluorophores energy emission to trigger an electronic circuit powering a very small geolocation device that can detect chemical and biological hazards. In FY06, will experiment with flourophore based detection of chemical and biological hazards under various environmental conditions. In FY07, will experiment with mimicking biological sensory functions to characterize the battlespace environment. Dynamic Situational Awareness - In FY04, defined an initial conceptual framework for Maneuver Course of Action (MCOA) solution analysis. In FY05, investigate and analyze critical measurement values for selection of MCOA solutions. In FY06, will investigate techniques for designing MCOA decision tools. In FY07, will investigate battlespace environment impacts on human decision making to support decision tool development.	2333	2388	2469	2562
Totals	2333	2388	2469	2562

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
53A	BATTLEFIELD ENV & SIG	2562	2798	2895	2961	2943	3019	3044	3067

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 have impacts on 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 and the Future Combat Systems (FCS) 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 DoD Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Research in optical and acoustical propagation in the atmosphere for enhanced Intelligence, Surveillance and Reconnaissance (ISR) capabilities for the Future Force and Future Combat Systems(FCS) to support situational understanding and rapid targeting. In FY04, characterized the polarimetric state of reflected thermal radiation on natural and environmentally degraded surfaces to improve target recognition/identification imaging. Investigated techniques to improve performance of battlefield acoustic sensor systems in degraded atmospheric conditions by incorporating self-awareness of their environment. In FY05, improve technologies that better quantify optical turbulence and characterize its different effects on performance of imaging sensors in battlefield environments. Perform research in high-fidelity acoustic signature simulation systems for devising synthetic acoustic signatures. In FY06, will investigate the capabilities for acoustic array tomography to be used for retrieving meteorological profiles. Will improve the optical technologies and processes used to enhance aerosol characterization. In FY07, will enhance urban acoustic propagation methodologies to improve modeling techniques and model performance.	1508	1727	1766	1830
- 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 FY04, evaluated micro-scale forecast and transport/diffusion models using real data for urban and complex terrain. Designed and performed preliminary investigation of an urban parameterized micro-scale meteorological model for Army decision aid applications in urban domains. In FY05, investigate new methods to determine the accuracy of small scale/limited domain models. Improve the Army tactical urban meteorology model to include simplified physics and parametric micro-scale models that can account for mean transport and dispersion around individual structures. In FY06, will formulate a new method for use of an improved near real-time three-dimensional environmental model to provide critical input to urban transport and dispersion models. In FY07, will investigate new methods for parameterization of mean heat and moisture fluxes that can be incorporated into an urban micro-scale meteorological model for improved transport/dispersion and signature modeling.	1054	1071	1129	1131
Totals	2562	2798	2895	2961

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
74A	HUMAN ENGINEERING	2621	2748	2858	2972	3010	3051	3078	3101

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 and situational complexity and ambiguity, which 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 with which to characterize soldier-system performance phenomena, and provide a sharable conceptual and operational framework for militarily purposeful 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 DoD Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Research to improve soldier auditory performance. In FY04, examined the effect of vibration on bone-conduction communication devices in a military vehicle and determined that bone-conduction communication effectiveness is primarily limited by vehicle noise rather than vehicle vibration. Completed a study to determine the effect of distance to the sound source on sound localization in a simulated open field and found that localization accuracy decreases with the distance and is affected by the sound source characteristics. Determined the effects of select hearing protection and helmets on speech communication capability of a soldier. In FY05, examine the effects of nonlinear hearing protection on soldier auditory performance in the presence of impulse noise. Investigate and transition optimal bone conduction microphone and vibrator placement to enable Future Force Warrior communication. In FY06, will formulate an algorithm for controlling perceived distance in immersive acoustic environments. Will predict detection of multimodal-spectrum sound in noisy environments. Will evaluate operational constraints of a remotely controlled binaural microphone for the Future Force Warrior (FFW). In FY07, will formulate an algorithm for predicting localization error due to headgear. Will investigate synergy between bone conduction and tactile communication for military applications for sniper detection.	1485	1592	1575	1671
- Research to assess, predict, and improve soldier performance. In FY04, validated the predictive Future Force Warrior (FFW) Cognitive Fightability Index (CogFit) with objective, subjective, and neuro-physiological data. Demonstrated that dynamic visual acuity evaluations were sensitive measures of system influences on soldier performance. Integrated models of soldier physical, cognitive, and decision making performance and transitioned them to the Army modeling community to provide human behavior representation in larger system-of-system simulations. In FY05, collect and integrate data on the effects of multi-modal sensory inputs (voice, digital messages, haptic warnings) to predict areas of high workload and systematically explore mitigation opportunities. In FY06, will expand capabilities for the prediction and maturation of cognitive readiness through assessment of neuro-cognitive functioning and time constraints under conditions of uncertainty. In FY07, will explore integrated use of real-time neuro-physiological and other objective measures and models to manage soldier situational overload in dynamic battlefield environments.	1136	1156	1283	1301
Totals	2621	2748	2858	2972

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
74F	PERS PERF & TRAINING	2595	2588	2710	2772	2870	2872	2895	2917

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, and human performance. 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 and improved skill retention; 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; and improving the match between Soldier skills and their jobs to optimize performance. Research is focused on issues fundamental to developing non-materiel solutions to transform the "human component" of warfighting in synchronization with the transformations in systems, technologies, weapons, and operational requirements to meet the goals 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 DoD Basic Research Plan (BRP). This project is managed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, research examined practical job knowledge assessment instruments; assessed trainability of sense-making (situation awareness) skills; assessed trainability of skills for rapid interpretation of large volumes of ambiguous electronic data; determined whether speed of response is an ability factor contributing to the quality of task performance; and developed improved electronically delivered instruction. In FY05, identify key individual differences, team characteristics, and learning processes that predict individual and team knowledge and skills needed for adaptive performance; assess spatial and temporal memory in electronic environments; develop test of mental flexibility; and develop models of basic human emotions using genetic algorithms. In FY06, projects will validate tests for measuring mental flexibility; identify optimizing training principles to achieve efficiency, durability, and flexibility in complex task environments; determine the influence of seductive detail on technology-delivered instruction; determine the effects of discrete positive and negative emotions on citizenship and deviant work behaviors; identify moderators of emotion-behavior linkages; and provide insight into how leader behaviors effect emotion-behavior linkages. In FY07, research will integrate existing theories of motivation and design feedback systems to achieve better task performance.	2595	2588	2710	2772
Totals	2595	2588	2710	2772

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
F20	ADV PROPULSION RSCH	1881	2041	2133	2218	2240	2232	2251	2267

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 conversion/sources, 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 DoD Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, investigated oil-free foil air bearing technology to enable future military turbine engines to operate without oil; reducing engine maintenance costs (50%) and weight (15%). Improved analytical models (incorporating hydrodynamic and compliant structure interactions) for journal and thrust oil-free foil air bearings. Investigated and experimentally measured thermal effects that influence the behavior and limit performance of high-speed and high-temperature foil air. Evaluated a laboratory prototype oil-free turbocharger for diesels and completed a preliminary oil-free turbocharger design for vehicles such as the Army Stryker, and Family of Medium Tactical Vehicles (FMTV). Conducted research in alternative energy conversion processes and energy sources, e.g., advanced constant volume combustion cycles (pulse detonation) and catalytic fuel cell reformation (leveraged NASA's commitment to onboard fuel cell use for flight weight systems). This research enhances engine system durability and performance and reduces logistics burden. In FY05, investigate ceramic materials processing and life prediction methods for high temperature engines; assess novel propulsion concepts for UAVs; investigate the influence of gear tooth surface treatments on gear operation after the loss-of-lubrication; evaluate oil-free foil air bearing misalignment tolerance limits and effects of ambient pressure on bearing performance. In FY06, will evaluate diagnostics techniques for hybrid bearings (ceramic rolling elements with steel races); complete lifing analysis of a first stage ceramic matrix composite turbine; investigate thermal and environmental barrier coating systems with 3000F capability; transition unsteady compressor flow analysis code to industry. In FY07, will analyze autonomous diagnostic and repair concepts for gas turbine engine components; complete baseline experimentation of gear tooth bending strength at elevated temperatures experienced in helicopter transmissions.	1881	2041	2133	2218
Totals	1881	2041	2133	2218

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H42	MATERIALS & MECHANICS	1942	2040	2120	2206	2235	2264	2283	2301

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 project 0602105A/AH84. 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 2004	FY 2005	FY 2006	FY 2007
Devise new materials and design capabilities, based upon fundamental concepts derived at the microscopic and nano-structural levels, for the Future Force. In FY04, proved the feasibility of using advanced composites with novel photonic and electromagnetic properties to provide multifunctional performance in lightweight armors; conducted research to narrow and control the size distribution of nano-particles; incorporated into continuum codes the first generation of a new ceramic damage model that includes novel damage kinetics and performed dynamic experiments to obtain critical model parameters for silicon carbide armor; and experimentally characterized dynamic fracture response of candidate anti-armor materials under ballistic loads. In FY05, show specific multifunctional performance gains in power generating structures and assess survivability gains that can be realized using novel photonic materials; examine nano-particle relationships between particle size and morphology for nano-systems synthesized in FY04; perform shock/re-shock/lateral release experiments on relevant armor ceramics to incorporate damaged material parameters into continuum codes and conduct benchmark analyses using new damage models; incorporate second generation dynamic fracture model into computational continuum mechanics code to enable development of improved anti-armor concepts. In FY06, will incorporate photonic materials and communications components into model survivable structures; use directed assembly techniques to control the nano-particle size and distribution of a functional nano-particles in a polymer matrix; fully transition ceramic damage model to armor design codes; and perform ballistic experiments of a fracture resistant penetrator prototype designed using new fracture models. In FY07, will enhance the synergistic effects of structure and electromagnetic interactions within model survivable structures; characterize transport behavior and relevant properties of nanoparticles.	1942	2040	2120	2206
Totals	1942	2040	2120	2206

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H43	RESEARCH IN BALLISTICS	5923	5962	7101	7324	7461	7411	7475	7531

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 lethal projectiles and missiles, and advanced armors for increased survivability of Army combat systems for the Future Force. This effort supports the OSD Advanced Energetics Initiative to mature the fundamental technologies required to transition the next generation of energetic materials into field use. 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 2004	FY 2005	FY 2006	FY 2007
- In support of the National Advanced Energetics Initiative and Army-specific basic research, expand and validate physics-based models and experimental techniques to devise and characterize chemical formulations that will enable design of novel insensitive high-energy propellants and explosives with tailored energy release for revolutionary Future Force lethality and survivability. In FY04, characterized and modeled the chemical and physical properties of novel energetic materials and established the relationship between particle size, energy density and release rate for insensitive high-energy propellants and explosives; explored the influence of these parameters on controlling mechanisms for initiation of combustion and detonation. In FY05, employ fundamental and advanced propulsion/detonation models and experimental techniques to understand managed energy release of insensitive high-energy propellants and explosives, including multiple-mode applications for energetic materials. In FY06, will devise condensed phase novel energetic materials models to couple and describe energy releasing processes within atomistic/molecular, micro, meso, and macro-scales for propellants and explosives; characterize nano-scale energetics in various stages of decomposition; devise functionally-graded nano-energetics; and model the effects of plasma ignition on multiple propellant grains. In FY07, will derive model-based relationships between energy localization from friction, fracturing, shock, jetting, void collapse, plastic deformation, viscous heating, adiabatic gas compression that control explosive and propellant formulation sensitivity supporting Insensitive Munitions.	3999	3668	4117	4208

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
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 FY04, explored correlations between ballistic performance of armor ceramics and fundamental material properties and material behaviors in the context of non-ballistic evaluation methods; conducted numerical study on the propagation velocity of shear bands as influenced by material imperfections and validated and matured improved models for computational continuum mechanics codes in support of improved analysis of armor/anti-armor interactions; devised algorithms to model fully-coupled roll controlled maneuver employing coupled Computational Fluid Dynamics(CFD)/structures and non-axisymmetric aerodynamics CFD to enable design of complex precision munitions for the Future Force. In FY05, develop understanding of damage evolution in ceramic materials and model penetration through advanced ceramic armor, capturing the observed material response for each phase of penetration; incorporate a model for adiabatic shear into simulations of armor/anti-armor interactions and compare with ballistic experiments; and prove capability to model fully coupled steady-roll controlled pitch-up maneuver of precision munitions and validate full high performance computational capability of coupled models employing multiple processors. In FY06, prove ability to accurately depict the degradation of ceramic materials in controlled high-rate experiments; devise generalized failure framework for combined fracture and shear localization of metallic materials; show bank to turn maneuver during vehicle thrust using coupled computational fluid mechanics, rigid body dynamics and guidance, navigation and control. 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.	1924	2294	2984	3116
Totals	5923	5962	7101	7324

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H44	ADV SENSORS RESEARCH	3791	3844	4000	4162	4214	4281	4318	4349

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 RF sensors. The technical approach focus is on exploitation of large scale electromagnetic 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, environmental detection, remote sensing and intelligent system distributive interactive simulations, and battlefield acoustic signal processing algorithms. Research performed under this project supports survivable sensor systems, displays, and environmental monitoring, both point and remote. Monolithic and hybrid optoelectronic structures in gallium arsenide and lithium niobate are investigated as integrated processors for novel signal and radar processing and control. Diffractive and micro-optic elements are investigated to enhance performance of imagers and optical processors to include the transmission of laser energy through the atmosphere for directed energy applications and high-data-rate optical communications; and the investigation and development of novel adaptive, active, and intelligent optical systems and techniques. Payoffs include low cost diverse displays, improved radar signal processing techniques that will allow existing systems to improve spatial resolution, improved ultra wideband radar technology, improved signal processing techniques for acoustic/seismic sensing systems, improved cryptography techniques, biological and chemical environmental sensing, and improved sensor protection. 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 2004	FY 2005	FY 2006	FY 2007
- Research addresses the maturation of technologies for adaptive, active, and intelligent optical systems for high-data-rate military communications and directed energy applications. In FY04, investigated wave division multiplexing in a free-space laser communication system; expanded the atmospheric laser optics test bed to include a network of laser communication systems; researched adaptive coding techniques for optical communications; and conducted research into the characterization and mitigation of atmospheric effects (i.e., turbulence, fog, rain, snow) on tactical directed energy weapons systems. In FY05, investigate hand-held laser communication applications; and perform research into adaptive beam control algorithms for target-in-the-loop Army self-defense laser weapon applications. In FY06 will investigate adaptive compression techniques and perform advanced analysis of target-in-the-loop scenarios with both cooperative and non-cooperative targets. In FY07, will perform research into the use of minimal configuration agile adaptive apertures for high-bandwidth optical communications and directed energy applications.	1449	1538	1601	1667

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Research focused on improving sensor capabilities to create more survivable/secure systems and displays, and improved environmental monitoring. In FY04, established capabilities to model multiple targets embedded in distributed clutter through L-band frequencies; advanced Surface Enhanced Raman Scattering (SERS) techniques to increase number of detectable biological agents; improved efficiency and optimization of processing techniques for networks of sensors and performed quantum cryptographic (QC) analyses; benchmarked QC demos; collaborated with CECOM on transitioning viable quantum computing systems to Army RDECs and evaluated other quantum computing systems. In FY05, quantify role of Ultra Wideband (UWB) Synthetic Aperture Radar (SAR) imaging artifacts in the ability to detect small and difficult targets and identify improvements; investigate Electron Beam Lithography (EBL) technology for generation of advanced SERS substrates; explore efficient signal processing algorithms for data fusion and networks of sensors of various modalities; make recommendations for applications of quantum information processing. In FY06, will utilize more accurate soil descriptions to determine the role of spatial and temporal variability in difficult target deployments such as underground plastic mines; investigate networking options of QC test beds and new areas in quantum information processing, and validate benchmark QC security analyses; optimize fabrication parameters of EBL substrates and benchmark SERS signatures for reproducibility and enhancements factors. In FY07, will use modeling and imaging tools to evaluate UWB image formation options for building penetration, mapping and personnel detection; collaborate with RDEC partners in performing QC test bed and networking studies, and assess transitionability of QC systems to future combat systems; explore efficient signal processing techniques for identification of biological pathogens using advanced SERS substrates.	2342	2306	2399	2495
Totals	3791	3844	4000	4162

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H45 AIR MOBILITY	2072	2073	2133	2218	2282	2314	2333	2352

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 DoD Basic Research Plan (BRP). Work in this PE is performed by the U.S. Army Aviation and Missile Research, Development, and Engineering Center, Redstone Arsenal, Alabama.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- In FY04, completed wind tunnel testing to reduce drag force of mast mount sensor (MMS) shape and fuselage. Conducted performance test for co-axial and ducted-fan unmanned aerial vehicle (UAV) and aero tests of diverse UAV fuselage shapes. In FY05, conduct rotor test to study the off-axis stability to increase helicopter handling quality. Conduct test to measure the Reynolds stress of the synthetic jet for blunt body drag reduction. In FY 06, will investigate rotor-induced power at high advance ratio flight. Will explore new acoustic prediction code for flight maneuvering. In FY 07, will research unsteady aerodynamics for flapping wing for micro UAV. Will conduct water channel test to validate the unsteady aero for flapping wing theory.	2072	2073	2133	2218
Totals	2072	2073	2133	2218

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H47	APPLIED PHYSICS RSCH	2520	2649	2781	2868	2905	2954	2980	3002

A. Mission Description and Budget Item Justification: This project investigates electronic materials and structures and energetic batteries and fuel cells to enable higher performance and more efficient electronic systems. This includes 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; the manipulation of cold atoms in an atom chip environment for application to very sensitive sensors and ultra-stable clocks. Impact of these investigations will be 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 DoD Basic Research Plan (BRP). Work is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- This research is focused on 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 sensitive gravitational, electric, and magnetic field sensors and ultra stable clocks. In FY04, evaluated solid electrolytes for rechargeable high-energy batteries; examined silicon carbide (SiC) structures and ohmic contacts for transition to efficient device designs; and devised a general-purpose laser cooling test system for the study of various cold atom chips with potential for application to ultra sensitive sensors and miniature atomic clocks. In FY05, synthesize/evaluate high energy phosphate cathode materials for Li-ion cells; evaluate catalysts for fuel processing for fuel cells; examine gallium nitride (GaN) structures and ohmic contacts for transition to efficient device designs, and reduce the surface roughness in SiC Metal-Oxide Semiconductor Field Effect Transistor (MOSFET) device structures to improve performance; and research cold atom chip and atom waveguide techniques experimentally and through simulations. In FY06, will show that a field plant in a GaN High Electron Mobility Transistor (HEMT) can be fabricated using ion implantation, and SiC Junction Barrier Shottky (JBS) diodes can be improved using selective area epitaxy; and validate propagation of cold atom condensates in atomic waveguides as a first step to atom chip sensors and clocks. In FY07, will evaluate the improved SiC and GaN devices in test circuits; and advance and validate initial versions of atom chip clock designs.	2520	2649	2781	2868
Totals	2520	2649	2781	2868

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H48	BATTLESPACE INFO & COMM RSC	5241	5526	5735	5957	6074	6086	6141	6188

A. Mission Description and Budget Item Justification: This project supports basic research to enable intelligent and survivable command, 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. The goal of this research is to address the areas of information assurance, and the related signal processing for wireless battlefield communications, along with intelligent systems for C4I. Major barriers to achieving the goals are overcoming 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, diverse networks with dynamic topologies, high level multi-path interference and fading, jamming and multi-access interference, and information warfare threats. The intelligent systems for C4I research will focus on providing the agent technology capabilities that will reduce the cognitive load on the commander, improve the timeliness, quality and effectiveness of actions and, in the long run, speed the decision-making process and reduce the size of tactical operation center (TOC) staffs. 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 2004	FY 2005	FY 2006	FY 2007
- Perform research to provide communications capability for a fully mobile, fully-communicating, situation-aware force operating in a highly dynamic, wireless, mobile networking environment populated by hundreds to thousands of networked nodes. In FY04, devised signal processing techniques to work under severe interference and poor channel conditions to maintain wide network coverage for disparate soldier, sensor, and airborne networks. In FY05, enhance signal processing for smart radios, coupled with network protocols, to provide intelligent multiple radio coexistence and radio frequency spectrum reuse to enable rapid deployment and networked information dominance in future threat scenarios. In FY06, will conduct laboratory experimentation to mature technologies for adaptive communications in a mobile, wireless, tactical network. In FY07, will perform experimental analysis to incorporate technologies to sensor/radio platforms.	2411	2542	2638	2740
- Design and implement a laboratory scale common information-processing infrastructure that aids in the transformation of data to knowledge to support decision-making under uncertainty. In FY04, incorporated mathematical and statistical techniques to accommodate uncertainty factors both in data and information during the aggregation process to create ready knowledge for the soldier to enhance decision making; extended language translation capabilities to include posting translations to databases; and performed machine translation evaluation research building statistical models. In FY05, devise analytical techniques to interface soldiers and robotic elements in a seamless manner in the battlefield information system. Extend language translation capabilities from printed text to voice capability and conduct experimentation with translation of low density languages. In FY06, will perform laboratory demo of low-density automated language translation and refine evaluation metrics for machine translation and correlation to autonomous robotic and soldier tasks. In FY07, will refine and optimize algorithms for soldier/robotic interface utilizing experimental machine translation.	1362	1381	1428	1483

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- 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 FY04, incorporated analytical and protocol techniques into mobile communication devices and systems to enhance robustness to unattended network intrusion and sensor spoofing for deployable sensor networks when operating under severe energy constraints; assessed fundamental limits on classifying and separating co-channel signals, transitioned results to Communications-Electronics Research, Development and Engineering Center (CERDEC); and formulated new transceiver architecture for ultra-wideband communications. In FY05, construct and populate tactical environmental assurance lab for mobile ad hoc networks (MANET); and evaluate and implement selected best of breed security services embedded authentication services for unattended static and mobile sensor networks deployable on the battlefield. In FY06, will perform experimentation and research for intrusion detection in MANETS that addresses resource consumption issues. In FY07, will investigate high mobility, channel impairment issues which are MANET-unique.	1468	1603	1669	1734
Totals	5241	5526	5735	5957

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601102A - DEFENSE RESEARCH SCIENCES**	**H52**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H52	EQUIP FOR THE SOLDIER	994	1058	1101	1141	1152	1164	1173	1182

A. Mission Description and Budget Item Justification: This project supports basic research to achieve technologies for the Soldier of the future and support Army Transformation. The research is focused on six core technology areas critical to systems: mathematical modeling, physical performance measurement, polymer science/textile technology, nanotechnology, biotechnology and food safety. Research is targeted on enhancing the mission performance, survivability, and sustainability of the Soldier by advancing the state of the art in defense against battlefield threats and hazards such as ballistics, chemical agents, lasers, environmental extremes, and rations shortfalls. The cited work is consistent with the 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 US Army Natick Soldier Center, Natick, MA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- In FY04, transitioned nanocomposite technology to warrior protective gear efforts in PE 0602786. Examined cognitive performance as function of nutrient and fluid intake under stressful conditions. Evaluated and quantified water distribution in intermediate moisture foods using magnetic resonance spectroscopy to enhance food safety and stability. Examined the relationship between perceived clothing fit and objective expert assessment of clothing fit for application to clothing design. Identified peptide-based recognition elements for detecting food pathogens. In FY05, determine effects of load distribution and moments of inertia on the biomechanics of gait and performance. Complete data analysis of nutrient effects on cognitive performance during severe cold stress. In FY06, will conduct research in ordered nanoarrays (optical properties/understanding of underlying physics) and transition results to applied research in PE 0602786; will couple modified peptide recognition elements to probe molecules for advanced food pathogen detection. In FY07, will perform basic research in nanocomposite fibers for advanced textiles; examine effects of Soldier knowledge, attitude and beliefs on acceptance of future military rations and clothing.	994	1058	1101	1141
Totals	994	1058	1101	1141

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H57	SCI PROB W/ MIL APPLIC	52881	53975	61380	63579	65534	66221	66792	67283

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, computer and information sciences), and environmental sciences (atmospheric and terrestrial sciences). 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, and supports research at nearly 200 institutions in 46 states. 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 extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Basic research in environmental and life sciences for Chemical Biological Detection (CBD), mine detection and revolutionary advances in sensors for soldier survivability. In FY04, isolated Phage Lytic enzymes to destroy bacteria that cause infectious diseases and that can be used as bio-warfare agents; discovered novel antifungal compounds produced as a result of plant-microbe interactions; used properties of human vision to reduce the computational complexity associated with processing real-time video streams; used time domain electromagnetic induction to locate and characterize unexploded objects; employed a multisensor approach to mapping of 2D and 3D geologic features from remotely sensed imagery. In FY05, seek to understand mechanisms of pathogenicity to combat terrorism and to aid in CB detection through intervention of organisms that cause disease; use molecular genetics to identify the molecular signals that affect soldier performance and endurance. In FY06, will study the structure of biofilms and the mechanisms of cell-to-cell communication to detect and prevent potential biological threats to water supplies; formulate atmospheric models of boundary layer to improve nighttime forecasts; complete physics-based modeling for microscale particle simulation to improve terrain mobility. In FY07 will conduct research into neuro-cognitively adaptive information displays to automatically match soldier perceptual, cognitive and motor abilities; provide airborne Doppler lidar with 4-D wind measurement capabilities; provide new simulations for soil moisture estimation for Army ground operations.	5263	5370	6110	6549
- Basic research in chemical sciences for advanced power generation, propellants, and protective materials. In FY04, devised a kinetics model for condensed phase combustion; investigated nano-shocks/molecular energy transfer; devised a new family of molecularly reinforced polymers for blast resistant transparent films; formulated a novel micro-fluidic chip for micro-assays of CBD agents. In FY05, expand research in computational electrochemistry for electrochemical power sources; explore the physics of operating molecular machines for CBD, signature management and laser protection; and devise polymers, fibers and novel architectures for materials with superior protection from all environments. In FY06, will conduct research in high efficiency, low pressure blowers to support fuel-cell based power sources for the soldier; devise new models of the solid state properties of propellants and explosives that do not require large blocks of computer time. In FY07, will transfer new gas/surface interaction theory into Army models for gun erosion; devise user friendly chemical reaction and kinetics models with computational fluid dynamics for chemical weapons incinerators.	5508	5620	6390	6620

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Basic research in physics for precision guidance, superior optics and signature management properties and secure communications. In FY04, established the viability of quantum imaging for a potential way to detect stealthy targets; showed superfluidity in Fermi degenerate gases for future sensors and clocks for positioning and precision guidance. In FY05, devise a theory for relativistic quantum information for use in assessing advanced Global Positioning System (GPS) and quantum computing protocols; determine electron dynamics in novel semiconductor heterostructures and nanostructures to guide the development of technology for efficient high power, low threshold lasers. In FY06, will devise negative index materials and photonic materials in the visible range for applications in imaging and sensing; prove a quantum algorithm that simulates hydrodynamics and aerodynamics much more efficiently than existing classical algorithms for improved design of munitions and vehicles; devise instrumentation for study of soft materials systems for soldier protection. In FY07, will provide accurate computational tools for design of new drugs through molecular physics, thereby subsuming biochemistry and quantum biology for a firmer basis for nanoscience.	7627	7785	8855	9170
- Basic research in communications and electronics for unmatched networked Command Control Communications Computing Intelligence Surveillance and Reconnaissance (C4ISR) capabilities. In FY04, used rare earth doped materials for photonic applications, and applied quantum dot intersub-band photo detectors for night vision devices and to create a new class of quantum-dot lasers for Army laser designators; modeled new bio-molecular architectures; showed the first room temperature magnetic semiconductors and greater than 100 GHz optical fiber communications. In FY05, explore advanced countermine techniques to enable faster and more accurate detection of mines by integrating seismo-acoustic and chemical sensors with electro-optics and advanced x-ray imaging. In FY06 will determine effects of 1-D nanostructures on the magnetic properties of ferromagnetic semiconductors; create technologies to design and implement highly mobile ad-hoc wireless tactical and sensor communications networks. In FY07, will devise an integrated nano-scale sensor platform at THz frequencies for biological detection; investigate methods for secure, trustworthy information delivery in mobile tactical systems.	11216	11450	13020	13485

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Basic research in mechanical and material sciences for survivable armor and more lethal anti-armor, improved mobility, and flexible displays for soldier systems. In FY04, advanced the understanding of active flow control for projectiles and air vehicles to improve precision strike; identified shear band deformation in bulk amorphous metals leading to improved penetrators; created in-situ X-ray techniques for monitoring stress and morphology for thin film displays; synthesized new hybrid biomimetic materials for high-performance structural, mechanical, optical and electronic materials thereby improving a wide range of Army components. In FY05, devise wafer-scale fabrication techniques to manufacture microturbines at reduced costs; fabricate micro-rocket engines from previous advances in microturbine research; conduct research in transparent conductive and emissive materials. In FY06, will devise planetary gear analysis tools for improved rotorcraft transmissions; formulate practical micro active flow control schemes for transonic and supersonic projectiles to improve accuracy; explore new concepts of phase inter-compatibility for maturation of passively “smart” materials. In FY07, will 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.	14312	14610	16615	16990
- Basic research in mathematical and computer sciences as the backbone for complex, multi-system analysis, modeling and simulation, and information systems. In FY04, translated statistical shape analysis to computer programs for improved target classification; devised self-organizing, self-healing mobile ad-hoc networking algorithms in order to facilitate rapid force deployment and reduce the logistics footprint; created conflict resolution architectures for multi-agent hybrid systems for robotics and UAVs. In FY05, devise low-order mathematical models of hysteresis nonlinearity to improve the performance and real-time control of smart materials leading toward micro electro-mechanical (MEM) actuators for rotor-blade surface flow control; and integrate research in mathematics, electrical engineering and signal processing to create digital communications based on principles of nonlinear dynamics and chaos for uninterrupted digital communications. In FY06, will devise a computer program containing algorithms for real-time implementation of non-linear filter target tracker. In FY07, will devise software to implement real time algorithms for identifying targets in noisy battlefield scenes.	8955	9140	10390	10765
Totals	52881	53975	61380	63579

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H66	ADV STRUCTURES RSCH	1425	1518	1588	1651	1661	1681	1696	1708

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 an 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 DoD Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, assessed unmanned aerial vehicle (UAV) utility of innovative wing designs inspired by naturally based morphologies; analyzed potential of actively-controlled rotor stability augmentation model for tilt rotor UAV; evaluated soft soil and water impact effects on crash occupant survivability; and assessed durability, damage tolerance, and failure mechanisms for embedded sensors/actuators in flexible structure. In FY05, characterize performance of advanced active twist rotor blade; investigate rotorcraft Computational Fluid Dynamic (CFD) modeling techniques to improve multi-body rotor aeroelastic modeling and simulation; investigate structural analysis methods to predict durability, damage tolerance, and failure of composite structures with embedded sensors/actuators. In FY06, will perform modeling and simulation studies of active control concepts for heavy lift rotorcraft; conduct subcomponent experiments to validate durability and damage tolerance predictions for composite structures with embedded sensors/actuators. In FY07, will 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.	1425	1518	1588	1651
Totals	1425	1518	1588	1651

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
S13	SCI BS/MED RSH INF DIS	9400	9691	10098	10492	10710	10854	10948	11028

A. Mission Description and Budget Item Justification: This project supports focused research for healthy, medically protected soldiers for the Future Force. Research efforts focus on investigation of medical countermeasures for naturally occurring diseases that are militarily significant due to their historically severe impact on military operations. Establishment of medical countermeasures will protect the force from infection and sustain operations by preventing hospitalizations and evacuations from the theater of operations. Work in this project is managed by the U.S. Army Medical Research and Materiel Command. The Army is the lead service for infectious disease research. 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, Silver Spring, MD, and its overseas laboratories; U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; and the Naval Medical Research Center, Silver Spring, MD, and its overseas laboratories.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, identified, using genomic technology, promising new targets to develop for inclusion into new vaccines against malaria and gained a better understanding of host-parasite interactions. Validated new models for high throughput screening and new drug discovery. In FY05, enhance and integrate techniques to exploit genomic information for vaccine and drug discovery efforts. In FY06, design and develop new drug and vaccine candidates for optimization and animal testing. In FY07, will utilize new genomic/proteomic (study of protein expression and function) technologies to identify new approaches to preventing malaria and evaluate alternative drug delivery systems.	5249	4291	4135	4964
In FY04, conducted studies to assess the incidence and types of diarrhea-causing agents in areas of deployment to determine suitability as vaccine test sites. In FY05, refine field site assessment for suitability for vaccine testing and select best sites. Study genetic diversity of diarrhea-causing strains. In FY06, will assess proteomic expression and study biology of genes of interest and incorporate this information into diarrheal disease vaccine program. In FY07, will perform studies to understand the mechanisms of pathogenesis (pathologic mechanisms occurring in the development of disease) and host/pathogen relationship of diarrheal organisms.	639	669	795	844

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, identified alternative approaches to create an effective and safe dengue fever vaccine. Identified genes from other lethal viral diseases such as Rift Valley Fever for incorporation into DNA vaccines. In FY05, identify field sites for testing dengue and hemorrhagic fever vaccines. In FY06, will identify viral and host cellular factors that determine the outcome of dengue virus infection; study the immunological mechanisms of protection in dengue and other lethal viruses. In FY07, will study host-virus interactions between flaviviruses that may affect vaccine strategies.	872	1602	1481	1270
In FY04, refined tests to detect insects carrying diseases transmissible to humans in areas of deployment. In FY05, evaluate effectiveness of integrated dengue vector preventive medicine control system in Central and South America, and Thailand. Assess approaches to sandfly control. In FY06, will enhance web-based insect vector identification resources and expand range of insect-borne diseases detected by current and new test systems. In FY07, will initiate comprehensive review of major mosquito collections to harness information for inclusion in worldwide distribution database for purposes of field identification and risk assessment and move insect-based disease tests to the concept exploration phase.	1832	2037	2664	2444
In FY04, identified infectious disease diagnostic components compatible for use in a Joint Biological Agent Identification and Diagnosis System. In FY05, identify approaches to supplement infectious disease diagnostics not currently compatible with joint system such as point of care diagnostics. In FY06, will evaluate a multiplexed real-time polymerase chain reaction (PCR, a technique to exponentially expand specific portions of DNA) for the simultaneous detection and identification of multiple endemic infectious diseases of military relevance. In FY07, will provide endemic infectious disease reagent sets for JBAIDS.	808	1092	1023	970
Totals	9400	9691	10098	10492

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
S14	SCI BS/CBT CAS CARE RS	4098	4143	4324	4495	4613	4677	4718	4751

A. Mission Description and Budget Item Justification: This project supports 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, Silver Spring, MD, and the U.S. Army Institute of Surgical Research, Fort Sam Houston, TX.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, defined measurable indicators of brain injury severity for use in directing treatment; studied potential chemical compounds that may block effects of severe blood loss on vital organs and tissues; defined measurable combat casualty parameters that can be used as indicators of need for immediate medic intervention vs. delayed intervention. Awarded multiple contracts through a consortium with the National Heart, Lung, and Blood Institute (NHLBI) to study shock after severe blood loss; and conducted conceptual development, technology discovery, and early studies to significantly mitigate or eliminate the impacts of battlefield injury, including severe hemorrhage, penetrating head injury, and mutilating soft-tissue and skeletal injury. In FY05, evaluate brain cooling to preserve brain tissue and function after penetrating brain injury (PBI); evaluate molecular mechanisms in response to a PBI; conduct early preclinical screening studies to select candidate compounds that may block effects of severe blood loss; define the impact of stabilizing body potassium concentrations on casualty survival; identify markers of resuscitation failure due to hemorrhage; attain regulatory approval for studies in accelerating soft-tissue wound healing. Continue basic research collaboration efforts with NHLBI. In FY06, will evaluate molecular mechanisms in response to PBI following neuroprotective drug treatment; begin testing additives to Ringer's Lactate (a resuscitation fluid) for reduction of response to hemorrhage; identify and characterize agents for accelerating soft-tissue wound healing; investigate results of treatment to reduce hemorrhage-induced tissue damage; continue basic research collaboration efforts with NHLBI. In FY07, will begin to define biomarkers in the PBI model after drug treatment; determine most effective agent for accelerating soft-tissue wound healing; and continue basic research collaboration efforts with NHLBI.	4098	4143	4324	4495
Totals	4098	4143	4324	4495

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
S15	SCI BS/ARMY OP MED RSH	5612	5786	6041	6273	6404	6490	6547	6593

A. Mission Description and Budget Item Justification: This project supports research for healthy, medically protected soldiers for the Future Force, focused on developing medical countermeasures to sustain performance when the opportunity for adequate rest is impaired or impossible due to combat conditions. 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. Research is conducted on militarily relevant aspects of environmental physiology and the neurobehavioral aspects of stress. The hazards of exposure to several classes of nonionizing radiation, directed energy, blast, jolt, vibration, noise, and toxic industrial chemicals as environmental contaminants are also investigated under this project. Specific tasks include delineation of injury, sustainment, and enhancement of the physiological and psychological capabilities of military personnel under combat operations in all environments. The six main thrust areas include nervous system regulation of stress and cognition, metabolic regulation, control of regional blood flow, oxidative stress interventions, tissue remodeling/plasticity, and 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, Silver Spring, MD; U.S. Army Research Institute of Environmental Medicine, Natick, MA; U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, identified the cytoprotective effect of herbimycin A to protect retinal pigmented epithelial cells (cells joined by small amounts of cementing substances) in culture against laser injury. This class of drugs is a potential therapy for laser eye injury and they will transition for evaluation in the intact eye. Explored the benefits of nutritional supplements to enhance metabolic rate for weight management, cold survival, and cognitive functions. This research will be used to develop rations designed to maximize performance outcomes in adverse environmental conditions. In FY05, apply proteomic and genomic assays to characterize laser injury mechanism and treatment responses. In FY06, will identify mechanism of laser-induced retinal injuries that result in secondary effects of retinal nerve fiber layer degeneration and choroidal (part of the eye) neovascularization (natural or surgically induced development of vessels in a tissue). In FY07, will extend findings from retinal injuries to in-vivo (within the living body) animal model.	1878	1934	1624	2098
In FY04, explored the relationship between sleep restriction (partial sleep loss) and need for recovery sleep in humans to more precisely predict sleep needs following operations that result in sleep restriction. In FY05, conduct studies on sleep genomics in collaboration with extramural genomics researchers. In FY06, will explore genomic basis of individual differences in resilience during sleep deprivation. In FY07, will develop a model of key determinants of individual fatigue resistance.	1864	1981	2811	2146
In FY04, completed a cold injury epidemiology (determination of specific cause of disease) study that identified an ethnogenetic component (unrelated to occupational specialty) associated with susceptibility to cold injury. In FY05, evaluate projected Future Force Warrior factors that increase cold strain and adversely impact performance during cold-weather operations. In FY06, will evaluate countermeasures to sustain performance during cold weather. In FY07, will develop predictive modeling capabilities and software for assessing cold strain and cold-weather performance during wet/water-borne conditions in fatigued soldiers.	1870	1871	1606	2029
Totals	5612	5786	6041	6273

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T22	SOIL & ROCK MECH	1910	1971	2031	2110	2157	2186	2205	2220

A. Mission Description and Budget Item Justification: This basic research creates the fundamental knowledge of 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 revolutionize the understanding of sensor data within a heterogeneous geological system. This encompasses geologic and structural material behavior, structural systems, and the interaction with dynamic and static loadings. Research needs include: 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 that supports the civil engineering technologies for force projection, mobility, maneuver support, and survivability of the Future Force in PE 0602784A Project T40, Mobility/Weapons Effects Technology. The cited work is consistent with the DoD Basic Research Plan (BRP), the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, performs this work.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Structural Materials - In FY04, conducted simulations of dynamic experiments of structural materials using both homogeneous and heterogeneous modeling techniques. Produced technique for mapping dynamic deformation and cracking in quasi-brittle materials. Produced model for predicting material response due to dynamic loading events. Near Surface Soil Behavior - In FY04, provided first-generation reinforcement models describing the interaction between soil particles and nontraditional stabilizers. Conducted laboratory experiments on size effect in compacted soils. In FY05, mature concept for low-velocity probe that could provide capability to remotely determine soil properties, determine mechanics of pressurized fabric structures for military logistics, and delineate a continuum mechanics theory critical to predictive models of vehicle-terrain interaction. In FY06, will identify and characterize the magnetic properties of soils that can mask the detection of mines and unexploded ordnance. Will produce techniques for improving the bond between concrete and steel. In FY07, will determine the feasibility of biological stabilization of soils for rapid construction of military surfaces. Will produce techniques for optimizing hardening reactions in organic cements allowing them to become the basis for high-strength, lightweight composites. Will mature concept for low-velocity probe that could provide capability to remotely determine soil properties.	1910	1971	2031	2110
Totals	1910	1971	2031	2110

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T23 BASIC RES MIL CONST	1602	1608	1666	1735	1787	1810	1827	1839

A. Mission Description and Budget Item Justification: This project supports facilities research initiatives: (1) forming an explicit and mathematically robust set of algorithms for geometrical reasoning, (2) assessing the conceptual feasibility of real-time sensors and agent derived models to simulate terrorist threat scenarios, and (3) developing novel and advanced concepts for mitigating the effect of chemical and geological agents in built structures. These efforts provide basic research leading to improved design capability for a range of facilities that 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. The project will lead to 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 PE 0602784A Projects T41 and T45, Military Facilities Engineering Technology and Cold Regions Engineering Technology. The cited work is consistent with the DoD Basic Research Plan (BRP), the Army Science and Technology Master Plan (ASTMP), and the Army Modernization Plan. The U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, performs this work.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, investigated fundamental thermodynamics and material properties that describe microencapsulated phase change material performance as it affects heat transfer of thermal fluids. Investigated underlying factors affecting the attenuation of electromagnetic fields under intense transient field conditions and develop models for the non-linear response. In FY05, formulate optimization algorithms suitable for rapid and flexible design of the continuum of facilities needed by the Future Force. In FY06, will determine the conceptual feasibility of using electrokinetic techniques to generate anion and cation species that form biocide films that are lethal to airborne pathogens. In FY07, will develop physics based constitutive equations for modeling the real-time behavior of the dispersion of airborne particulates.	1602	1608	1666	1735
Totals	1602	1608	1666	1735

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T24	SNOW/ICE & FROZEN SOIL	1189	1292	1361	1413	1412	1425	1438	1448

A. Mission Description and Budget Item Justification: This basic research focuses on two interrelated topic areas, 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 thus 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 in response to changing terrain state. 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 U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Terrain State and Signature Physics – In FY04, extended theory of near surface meteorological variables at the micro-scale and completed theory for distribution of energy components associated with 3-dimensional discontinuous canopies, providing new capability for detection of partially obscured targets. In FY05, establish effects of buildings and barriers on acoustic-seismic propagation in urban settings and define the turbulence and topographic roughness interaction for acoustic signals. Establish understanding of pavement mechanical properties and pavement degradation processes as a function of soil, pavement type, and moisture-temperature variations. Investigate methods to remotely extract or infer soil, moisture, temperature at depth, and vegetation attributes. In FY06, will formulate 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, will 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.	1189	1292	1361	1413
Totals	1189	1292	1361	1413

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T25	ENVIRONMENTAL RES-COE	4501	4473	4650	4835	4995	5065	5109	5147

A. Mission Description and Budget Item Justification: Environmental quality basic research investigates fundamental scientific principles and phenomena necessary to ensure efficient development of the technologies needed to address Army issues in the restoration, compliance, conservation, and non-industrial pollution prevention areas. These efforts foster technology progress and innovation directed toward: 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 rendering harmless waste in water, soil and sediments 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; and reducing pollution associated with military activities. The project supports applied research under PE 0602720A, Projects F25, 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 DoD Basic Research Plan (BRP). Work in this project is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Environmental and Ecological Fate of Explosives, Energetics, and Other Contaminants – In FY04, determined the effects of microbial and geochemical processes associated with manganese oxides on the environmental fate of metals and inorganics in groundwater and soil to model the transport of contaminants and to improve treatment processes. Established a means to determine the toxicology of selected explosive compounds in mammals using gene expression data. Identified new mechanisms (gene probes, micro arrays, and assays) for detecting the reaction of critical microbial populations to numerous contaminants of military interest. In FY05, correlate the molecular spectral characteristics with computation chemistry to determine the affinity of contaminants to produce fast forming less toxic chemical byproducts. Correlate biosensor response to explosive additions as a function of soil condition. In FY06, will determine the potential mechanisms of toxicity and sublethal effects of individual and interactive mixtures of explosives. Will use bioinformatics (computational biology) as the basis for constructing DNA probes and to characterize DNA isolated from soil. In FY07, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to contaminant toxicity assessment and environmental risk assessment.	1490	1481	1539	1600
Remediation of Explosives, Energetics, and UXO – In FY04, determined the chemical, physical, and biological transformation of crystalline explosive residues on firing ranges for improved cleanup alternatives and risk-based assessments. Described the microbial physiology, biochemistry and genetics of explosives contaminants on military ranges for tailored in-place site cleanup. In FY05, describe propellant attenuation on ranges via the management of natural soil cycles. Pursue in situ explosive biodegradation mechanisms and direct analysis methods to identify explosives degradation mechanisms of contaminated soils. In FY06, will use 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. Will establish the relationship of explosives-energetics affinity of being bio/chemically transformed into other toxic/non-toxic chemicals using kinetic models. Will refine 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. In FY07, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to contaminant mineralization.	1622	1612	1676	1743

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Training Land Natural Resources – In FY04, determined genetic traits and differences in specific native grasses to enhance resilience for military land rehabilitation. Determined the effects of military training noise on the feeding, roosting, and flight behaviors of endangered bats for improved design/maintenance of Army ranges. In FY05, describe physical, chemical, and biological phenomena impacting ecosystem maintenance, mitigation, and rehabilitation for Army lands. Evaluate changes in endangered bats' hearing sensitivity due to shock wave pressure associated with Army test and training ranges. In FY06, will determine viable population levels of threatened and endangered species, as affected by the genetic diversity within populations, and quantify the amount of genetic exchange between populations due to habitat fragmentation. In FY07, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to ecosystem maintenance, mitigation, and rehabilitation.	1389	1380	1435	1492
Totals	4501	4473	4650	4835

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		82721	83959	67201	67510	69097	70300	71701	73127
D55	UNIVERSITY RESEARCH INITIATIVE	62258	71976	67201	67510	69097	70300	71701	73127
D58	URI ACTIVITIES (CA)	20463	9108	0	0	0	0	0	0
D62	BIOINFORMATICS RESEARCH (CA)	0	1917	0	0	0	0	0	0
D63	INST OF BIOENGINEERING AND NANOSCIENCE IN ADV MED	0	958	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: In FY03 and prior years, the Office of the Secretary of Defense University Research Initiative (URI) PE 601103D8Z contained funds for several university research, education and infrastructure programs. Starting in FY04, a portion of these OSD funds were transferred to the Army in Project D55 in support of the Multidisciplinary University Research Initiative (MURI), the Defense University Research Instrumentation Program (DURIP) and the Presidential Early Career Awards for Scientists and Engineers (PECASE) program. The MURI program supports basic research in a wide range of scientific and engineering disciplines pertinent to maintaining the U.S. 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. 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 URIs. 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).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	75133	70413	66450
Current Budget (FY 2006/2007 PB)	83959	67201	67510
Total Adjustments	8826	-3212	1060
Net of Program/Database Changes			
Congressional Program Reductions	-1260		
Congressional Rescissions			
Congressional Increases	12500		
Reprogrammings			
SBIR/STTR Transfer	-2414		
Adjustments to Budget Years		-3212	1060

Change Summary Explanation:

Nine FY05 Congressional Adds totaling $12500 were added to this PE.

FY05 Congressional Adds with no R-2As:

($1438) Army Force Protection, Project D58: The purpose of this one year Congressional add is to fund basic research in Army force protection. No additional funding is required to complete this project.

($1918) Bioinformatics Research, Project D62: The purpose of this one year Congressional add is to fund basic research in bioinformatics. No additional funds are required to complete this project.

($959) Cognitive Wireless Networks, Project D58: The purpose of this one year Congressional add is to fund basic research in cognitive wireless networks.

($959) Desert Environmental Research, Project D58: The purpose of this one year Congressional add is to fund desert environmental research at the University of Redlands, Redlands, CA. No additional funds are required to complete this project.

($958) Institute of Bioengineering and Nanoscience in Advanced Medicine, Project D63: The purpose of this one year Congressional add is to fund research at the Institute for Bioengineering and Nanoscience in Advanced Medicine at Northwestern University, Chicago, IL. No additional funds are required to complete this project.

($959) Laboratory for Engineered Human Protection (LEHP), Project D58: The purpose of this one year Congressional add is to fund research at Philadelphia University on the development and evaluation of comfort-driven protective systems for the military and the civilian sectors. No additional funds are required to complete this project.

($1918) Low temperature Research Center, Project D58: The purpose of this one year Congressional add is to fund research at Wayne State University to provide an understanding of the effects of low temperatures on ground vehicle systems to enhance soldier mobility. No additional funding is required to complete this project

($959) MEMS Sensor for Rolling Element Bearing, Project D58: The purpose of this one year Congressional add is to fund research in micro-electro-mechanical systems sensors in rolling element bearings. No additional funds are required to complete this project.

($1918) Smart Responsive Nanocomposite Systems, Project D58: The purpose of this one year Congressional add is to fund research in nanocomposites. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
D55	UNIVERSITY RESEARCH INITIATIVE	62258	71976	67201	67510	69097	70300	71701	73127

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 U.S. 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 PE 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).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, made 9 new awards and continued supporting the 54 MURI awards made in prior years. A few key continuing MURI research topics include: National Nanoscience Initiative, Critical Infrastructure Protection, Fundamental Issues Underlying Infrared Detection; Ultrawide-band Communications; New Adaptive, Reconfigurable RF Radio/Sensor Concepts; Biological and Chemical Sensing at Terahertz Frequency. In FY05, continue supporting MURI awards made in prior years and make 8 new awards. Topic areas for the FY05 MURI research competition will be in Wireless Communications Networks, Autonomous and Semi-Autonomous Vehicle Swarms, Electronic Systems, Quantum Imaging, Network Battlefield Training, Materials Engineering, and Future Force Insensitive Munitions. In FY06 and FY07 support MURI awards made in prior years and initiate new awards in research critical to the Army's Future Operating Capabilities with an emphasis on biomolecular electronics, bio-electrochemical sensors, and human engineering research for humans-in-automation systems.	50501	57223	50097	52364
In FY04 continued supporting those PECASE investigators started in prior years. In FY05, FY06, FY07 competitively select two new young investigators each year under the PECASE program.	899	1053	954	1016
In FY04, awarded 63 competitive grants for the acquisition of research instrumentation under the Defense University Research Instrumentation Program (DURIP). Emphasis is on instrumentation vital to the discovery of new scientific knowledge and the advancement of Army transformational technologies. Research instrumentation awards are generally over $150K each. In FY05, award competitive grants for the acquisition of research instrumentation. Continue to emphasize instrumentation that enhances the research infrastructure and provides new research capabilities to enable scientific exploration and discovery in burgeoning areas vital to Army transformational technologies. In FY05, FY06, FY07 award additional competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army Transformation.	10858	13700	16150	14130
Totals	62258	71976	67201	67510

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601104A - University and Industry Research Centers

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		95352	100066	81953	85938	88984	91779	93400	95051
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	0	4560	2509	2593	2646	2700	2753	2808
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	0	4620	6825	7025	7130	7234	7378	7524
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	0	2402	2510	2593	2646	2700	2753	2808
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	7902	7762	8178	8481	8722	8841	9017	9196
H53	ADV DIS INTR SIM RSCH	2468	2364	2618	2714	2780	2844	2900	2958
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	6192	6125	6514	6702	6902	6982	7121	7262
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5988	5852	6203	6578	6754	7121	7262	7407
H59	UNIV CENTERS OF EXCEL	20665	6286	1864	1923	1973	2009	2049	2090
H62	ELECTROMECH/HYPER PHYS	5653	5357	5792	6126	6233	6329	6454	6582
H64	MATERIALS CENTER	2816	3076	2464	2664	2730	2790	2845	2901
H65	MICROELECTRONICS CTR	936	897	946	1051	1078	1101	1123	1145
H73	NAT AUTO CENTER	7840	7422	2958	3074	3191	3233	3261	3286
HB3	IMMERSIVE ENVIRONMENTS BASIC RSCH INITIATIVES (CA)	1343	0	0	0	0	0	0	0
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	11655	10582	7184	7315	7543	7757	7911	8068
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5732	5498	5646	5739	5884	6016	6136	6257
J12	NANOTECHNOLOGY	9446	9097	9933	10278	10535	10769	10983	11201
J13	UNIVERSITY AND INDUSTRY INITIATIVES (CA)	6716	18166	0	0	0	0	0	0
J14	ECYBERMISSION	0	0	4809	4963	5091	5184	5287	5392

J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	0	0	5000	6119	7146	8169	8167	8166

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 catagories: Collaborative Technology Alliances (CTAs), University Centers of Excellence, 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 includes the Army's Centers of Excellence (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 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 full spectrum dominance, 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 design. 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 U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC); the Simulation & Training Technology Center (STTC); and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	77658	76705	80157
Current Budget (FY 2006/2007 PB)	100066	81953	85938
Total Adjustments	22408	5248	5781
Net of Program/Database Changes			
Congressional Program Reductions	-1496		
Congressional Rescissions			
Congressional Increases	26776		
Reprogrammings			
SBIR/STTR Transfer	-2872		
Adjustments to Budget Years		5248	5781

Change Summary Explanation:

Nineteen FY05 Congressional Adds totaling $26776 were added to this PE.

FY05 Congressional Adds with no R-2A:
($959) Basic Research for Infrastructure Protection from Terrorist Attacks, Project J13: The purpose of this one year Congressional add is to fund basic research in infrastructure protection from terrorist attacks. No additional funding is required to complete this project.

($1438) Center for Advanced Sensors, Project J13: The purpose of this one year Congressional add is to fund basic research in advanced sensors. No additional funding is required to complete this project.

($1918) Center for Ferroelectric Electronic - Photonic Nanodevices, Project J13. The purpose of this one year Congressional add is to perform research in ferroelectric and photonic devices. No additional funding is required to complete this project.

($959) Center for Nanomaterials Research, Project J13. The purpose of this one year Congressional add is to perform nanomaterial research.

No additional funding is required to complete this project.

($959) Electronic Engineering Technology Program, Project J13: The purpose of this one year Congressional add is to fund basic research in electronic engineering technology. No additional funding is required to complete this project.

($959) Eye and Sensor Protection Against Laser Sources, Project J13. The purpose of this one year Congressional add is to perform research in eye and sensor protection against lasers. No additional funding is required to complete this project.

($1151) Information Assurance Research, Project J13: The purpose of this one year Congressional add is to fund basic research in information assurance at Norfolk State University, VA. No additional funding is required to complete this project.

($959) Interactive Training Tools to Promote Emergency Procedures in High-Rise Buildings and Mitigate Disasters from Attacks, Fires or Other Threats, Project J13: The purpose of this one year Congressional add is to fund basic research in interactive training tools to promote emergency procedures in high-rise buildings. No additional funding is required to complete this project.

($959) Nanotubes, Project J13. The purpose of this one year Congressional add is to perform research in nanotubes. No additional funding is required to complete this project.

($2398) National Infotonics Research, Project J13: The purpose of this one year Congressional add is to fund basic research in infotonics. No additional funding is required to complete this project.

($959) National Security Network Testbed, Project J13: The purpose of this one year Congressional add is to fund basic research in national security networks. No additional funding is required to complete this project.

($1438) Next Generation Joining Technology Research Initiative, Project J13: The purpose of this one year Congressional add is to fund basic research in joining technology. No additional funding is required to complete this project.

($1438) NOLES Composite Materials, Project J13: The purpose of this one year Congressional add is to fund basic research in composite materials. No additional funding is required to complete this project.

($959) Rapidly Deployable Visualization for Training and Simulation in Urban Terrains, Project J13. The purpose of this one year Congressional add is to perform research supporting deployable visualization for training and simulation. No additional funding is required to complete this project.

($719) Small Trailer Corrosion Prevention Program, Project J13. The purpose of this one year Congressional add is to fund basic research in corros

ion prevention. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	0	4560	2509	2593	2646	2700	2753	2808

A. Mission Description and Budget Item Justification: Centers of Excellence have proven to be 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 the 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 TRADOC Battlelabs 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 vital to Army Transformation. This project was previously funded in PE 611104A 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).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- This program was initiated in FY04 in this PE under Project H59. In FY05, fully establish the HBCU/MI Centers of Excellence for Battlefield Capability Enhancements: Tuskegee University – research on flexible extremities protection; North Carolina A&T University – research on flexible displays and human engineering research in cognitive strategies – "sense making; , Tennessee State University – research on sensor fusion; and Prairie View University – research on Beyond-Line-of-Sight Continue to forge close collaborative working relationships with TRADOC Battle Labs and accelerate technology transitions to Army labs/centers and industry. In FY06, will conduct rheological characterization studies of fabric composites for flexible extremities protection; investigate 2D stationary and non-stationary distributed sensors with varying operational modalities; characterize non-crystalline wide band gap materials for environmentally stable flexible displays; conduct cognitive process experiments for human-centric decision making. In FY07, will model and simulate wave propagation of shear thickening fluid/fabric composites for extremities protection; expand sensing taxonomy to 3D located sensors and combine with 2D and 3D non-stationary sensor nodes; characterize electrical and optical properties of organic multilayer films for flexible displays; model adaptivity of decision maker in dynamic situations.	0	2310	2509	2593
- The purpose of this one year Congressional add is to support basic research at Lincoln University, a Historically Black University. No additional funding is required to complete this project.	0	2250	0	0
Totals	0	4560	2509	2593

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	0	4620	6825	7025	7130	7234	7378	7524

A. Mission Description and Budget Item Justification: This project was previously funded in PE 611104A Project H59 and is a FY05 restructuring of ongoing research into a distinct project for visibility and management. This Project supports the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center located at the University of California-Santa Barbara, and two major subcontractors, 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 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. 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).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Institute for Collaborative Biotechnologies: In FY04, this program was funded under Project BH59. In FY05, explore biologically derived and biologically inspired synthesis and processing for enhanced performance materials properties; investigate and leverage design and characterization of biological networks as insight for battlefield networks. In FY06, will formulate fastest available method for generating binding peptides for Army biosensing, diagnostics and therapeutics applications; will devise the collective optical response of multichromophore macromolecules and DNA-specific electrode surfaces and microfabrication for detection and identification of multiple DNA sequences for threat, Identification Friend or Foe (IFF) and soldier status-analysis; will adapt unique proteomics technology and diagnostic markers into microfluidics-based modified proteomics libraries for advanced analysis in early detection of human pathology; and will establish the roles of interfaces for potential use of biological + non-biological hybrid components in advanced electronic and photonic devices. In FY07, will provide foundation for incorporation of deterministic and stochastic dynamic models from biological systems, endowing engineered Army networks with robustness; will 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; will enable controlled surface functionalization and ligand display on, and integration into, materials for application in sensors, multi-functional materials, and device assembly; and will devise genetically engineered microbial systems that efficiently incorporate un-natural amino acids into proteins for unique materials application for the Army.	0	4620	6825	7025
Totals	0	4620	6825	7025

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	0	2402	2510	2593	2646	2700	2753	2808

A. Mission Description and Budget Item Justification: This project was previously funded in PE 601104A project H59 and is a restructuring of ongoing research into a distinct project for visibility and management. This project conducts basic research in key scientific 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 will be conducted in 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 research program, 62618 H3, 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 2004	FY 2005	FY 2006	FY 2007
- Robotics Collaborative Technology Alliance: Explore new opportunities to enable revolutionary autonomous mobility for the Future Force. Research is an integral part of the larger Army Robotics Program and feeds technology into PE 0602618 (Robotics Technology). 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 FY05, research focuses on understanding sensor phenomenology and determining new methodologies to enable accurate terrain classification in the local environment permitting intelligent autonomous tactical movement through complex terrain. Emphasis will be upon the advancing specialized algorithms able to classify distinct objects, e.g., water, wire structures, embedded in a complex background to enable higher speed cross-country mobility required for Future Combat Systems unmanned ground elements. Investigate control concepts that allow autonomous systems to adapt to dynamic environments and learn from past performance in a mixed manned/unmanned collaborative environment thus reducing the cognitive workload placed upon soldiers controlling unmanned systems. Characterize the performance of a probabilistic, genetic algorithm and market based algorithms in an M&S evaluation framework for autonomous robot scout systems. In FY06, will compare adaptive capability of tactical behaviors to a baseline approach utilizing task decomposition/case-based machine behavior; and will perform assessment for Improvised Explosive Devices (IED) threat mitigation designed to stress both perception and control strategies, proving concept viability and mitigating the risk associated with meeting FCS objectives. In FY07, will evaluate tactical behavior of core algorithmic structures and determine performance of best features of each in various tactical behavior applications stressing performance in changing tactical situations in complex environments.	0	2402	2510	2593
Totals	0	2402	2510	2593

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	7902	7762	8178	8481	8722	8841	9017	9196

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 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 communications and networks technology to PE 0602783 (Computer and Software Technology). The results of this work will significantly affect Future Force communications/networking formulation efforts. 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 2004	FY 2005	FY 2006	FY 2007
- 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. In FY04, integrated self-organizing and auto configuring subnet protocols that enable persistent on-the-move communication sessions in highly mobile conditions. In FY05, validate self-organizing and auto configuring subnet protocols that enable persistent on-the-move communication sessions in highly mobile conditions. In FY06, will devise and validate auto configuration protocols that allow mobile networks to adapt to dynamic conditions. In FY07, will conduct analytical and experimental studies validating dynamic and survivable resource pooling to enable mobile networks to exploit distributed network infrastructures.	2675	2670	2862	2971
- 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 FY04, conducted analytical and experimental studies investigating high performance multiple access techniques and high spectral efficiency modulation schemes for communications on the move. Combined Digital Signal Processing (DSP) and hardware to enhance Radio Frequency (RF) transmission efficiency. In FY05, conduct analytical and experimental studies validating high performance multiple access techniques and high spectral efficiency modulation schemes for communications on the move. In FY06, will conduct 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, will conduct analytical and experimental studies of signal processing aided medium access control algorithms that improves communications performance while on-the-move.	1972	1962	2044	2124
- 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 FY04, conducted analytical and experimental studies investigating low probability of detection waveforms, interference mitigation techniques, and anti-jam modulation to enable survivable communications and spectrum reuse. In FY05, conduct analytical and experimental studies validating low probability of detection waveforms, interference mitigation techniques, and anti-jam modulation to enable survivable communications and spectrum reuse. Investigate ultra-violet non-line-of-sight sensor communications. In FY06, will conduct analytical and experimental studies of frequency-hopping systems that enable robust and mobile anti-jam effectiveness. In FY07, will devise and study sensor array processing and interference techniques that enable adaptive antennas for improved interference rejection and spectrum reuse.	1653	1574	1636	1691

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Tactical Information Protection: perform research in scaleable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY04, conducted analytical studies investigating a highly efficient and noise robust security suite with distributed trust, distributed key management, and intrusion detection. In FY05, conduct analytical and experimental studies validating a highly efficient and noise robust security suite with distributed trust, distributed key management, and intrusion detection. In FY06, will conduct 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, will devise and study security schemes for distributed servers supporting dynamic network infrastructures.	1602	1556	1636	1695
Totals	7902	7762	8178	8481

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H53	ADV DIS INTR SIM RSCH	2468	2364	2618	2714	2780	2844	2900	2958

A. Mission Description and Budget Item Justification: This project supports Army critical research at the Army High Performance Computer Research Center (AHPCRC). The AHPCRC research is focused on the Future Force, 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 a long-term collaboration between the Army Research Laboratory and competitively selected Army Center of Excellence in Information Sciences (ACEIS). The objective of this center is to perform research in knowledge fusion technology in support of global and tactical battle command for the Future Force. The most significant technical barrier is determining how fusion can function usefully as a service in the rapidly evolving, universal distributed web environment to build systems to support reasoning and inference of human decision processes. Areas of emphasis include real-time and near-real-time multi-sensor fusion for situational awareness and threat prediction. A key problem to be solved is information overload. Major portions of the work of the ACEIS are performed at Clark Atlanta University and Morgan State University; both are HBCU institutions. 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 2004	FY 2005	FY 2006	FY 2007
- Perform research at the Army High Performance Computing Research Center (AHPCRC) that requires computationally intensive algorithms in the areas of projectile target interaction, signature modeling, chemical/biological defense, nano-science and nano-mechanics, and enabling technologies to include scientific visualization that support the Future Force transition path. In FY04, created interdisciplinary tools and validated integration of chem-bio defense propagation with Army meteorology models, to include data mining approaches for chemical-biological models and weather models; integrated intrusion detection software into Army systems; created algorithms for computational nanomechanics; validated computational fluid dynamics and structural mechanics approaches with relevant Army applications. In FY05, create novel computational algorithms for chemical-biological defense at the cell level; explore algorithms at nano-level and mechanics towards multifunctional nano-materials; explore coupled approaches for integrating Army meteorology models with electromagnetics; investigate new scalable higher order techniques in mechanics and electromagnetics; explore scientific visualization approaches to meet new hardware, software, and user requirements. In FY06, will integrate scalable software for intrusion detection and validate for Army application; will implement dial-up software to enhance interior ballistics and validate with Army application; and will explore nanotechnologies scalable algorithm toward relevant Army applications. In FY07, will complete an 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; and will devise algorithms for flexible-rigid multi-body dynamics and new methods for nonlinear computational structural mechanics.	1998	2000	2000	2000
- Perform research into knowledge fusion technologies and systems that enhance situational awareness and threat prediction on the battlefield to improve tactical and global battle command. In FY04, performed experiments on distributed databases using intelligent agent technologies; implemented network-centric, service-based fusion research platform to test fusion algorithms at points all along the sensor-to-warrior chain. In FY05, show distributed streaming video fused with geographic data to present real-time battlefield on-request information delivery. In FY06, will extend research to include indexing and queries that cluster around time and space using superimposed visualization to enhance imagery. In FY07, will investigate additional heterogeneous multimedia data sources for potential extension and experimentation in a mobile environment.	470	364	618	714
Totals	2468	2364	2618	2714

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	6192	6125	6514	6702	6902	6982	7121	7262

A. Mission Description and Budget Item Justification: This project supports a competitively selected industry/university consortium, the Advanced Sensor Collaborative Technology Alliance (CTA), for the purpose of leveraging world-class commercial research necessary to address Future Force and Army Transformation needs. The CTA links a broad range of government technology agencies and industry/academia partners with the Army Research Lab (ARL). This Advanced Sensors CTA conducts innovative research focusing on three main technical areas: micro-sensors, electro-optic smart sensors, and advanced radar concepts. The payoff to the warfighter will be advanced sensing technologies to support Future Force requirements. The technical areas addressed under this project include overcoming technical barriers associated with: autonomous calibration and management of micro sensor networks; multi-domain smart sensors (includes multi-spectral infrared focal plane arrays); a novel concept for laser radar (LADAR); multifunction radar sensors; and sensor modeling and algorithms for automatic target recognition (ATR) involving fusion of data from multiple sensors and signal processing. 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. Work in this CTA accelerates the transition of technology to PE 0602120 (Sensors and Electronic Survivability). 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 2004	FY 2005	FY 2006	FY 2007
- Perform microsensor research focused on sensors, algorithms, low-power signal processing, and autonomous sensor/network management for the unattended sensor network component of FCS, resulting in technology transfer and delivery of sensor nodes to applied research. In FY04, evaluated significant reduction of sensor network power budget to increase sensor operational lifetime. In FY05, implement multi-sensor (acoustic & infrared image) fusion on a cluster of five nodes for detection, identification and tracking of multiple vehicles. For FY06, will implement multi-sensor fusion on multiple clusters for detection, identification and tracking of multiple targets (people and vehicles). For FY07, will extend sensor fusion to include robotic/unmanned aerial vehicles and ground vehicles, with autonomous sensor management and self-calibration.	2473	2450	2606	2681
- Perform electro-optics research focused on infrared sensors, laser radar, hyperspectral imaging, and automatic target recognition algorithms for improved situational awareness and targeting. In FY04, devised and characterized separate passive infrared imager and active laser radar imager. In FY05, devise prototype 8x8-pixel integrated active/passive imager; fabricate a medium wavelength infrared (MWIR) 320 x 256 gallium antimonide passive imaging array; validate mercury cadmium telluride MWIR passive imaging array with operating temperature of 120 Kelvin. In FY06, will validate a 32 x 32 integrated active/passive imager. In FY 07, will fabricate a long wavelength infrared 320x256 gallium antimonide passive array.	2167	2144	2280	2343
- Perform radar research focused on low-cost electronically scanned antennas; integration of analog and digital components, advanced materials and device designs; and system studies to increase radar performance and reduce the detection of FCS platforms. In FY04, completed the electronically scanned antenna subsystem comprised of low-cost phase control modules. In FY05, verify low-power Micro-Electrical-Mechanical System (MEMS) phase shifters for electronically scanned antennas. In FY06, will validate multi-bit low-temperature-growth gallium arsenide phase shifter with low loss. In FY07, will fabricate low-cost liquid crystal polymer MEMS phase shifter and validate in an electronically scanned antenna array.	1552	1531	1628	1678
Totals	6192	6125	6514	6702

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5988	5852	6203	6578	6754	7121	7262	7407

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 that will provide real-time situation awareness, distributed commander-staff-subordinate collaboration and planning, and execution monitoring in a high tempo, high stress battlefield environment with 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 situation 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; architecture; 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 PE 0602783 (Computer and Software 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 2004	FY 2005	FY 2006	FY 2007
- Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers). In FY04, investigated naturalistic planning and decision-making, specifically the constructs of mental simulation and pattern matching, as key cognitive processes in projecting battlefield scenario outcomes. Conducted virtual reality simulation experiments to provide the necessary data to enhance computational models that are sensitive to contextual cues. In FY05, validate computational models of cognitive processing to include models which predict operator performance while interacting with graphic displays. In FY06, will investigate applicability of social network models of commander and staff interactions for organizational design. In FY07, will validate architecture for information fusion, which uses diagrammatic reasoning as an aid to evaluate the commander's preferred course of action.	2177	2165	2295	2434
- 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 FY04, evaluated cognitively based methods and procedures for improved situation awareness, team collaboration and decision making in a distributed environment. Results indicated that the common operational picture (display), audio conferencing, and face-to-face were the most effective tools for planning and execution overall; but instant messaging was most effective in execution. In FY05, integrate concepts, equipment, and software to examine multi-national coalition collaboration in a stability and support operation. In FY06, will design and complete experiments to examine variations on decision-making processes and procedures and the use of advanced digital tools for continuous planning in a distributed environment. In FY07, will validate prototype architecture for collaboration and visualization test bed.	1208	1145	1210	1284
- User-adaptive interfaces: explore ideas, frameworks, and technologies that assist the Soldier in understanding, problem solving, planning and decision-making. In FY04, evaluated feedback frameworks for enhancing situation awareness. Experiments indicated that displays that combined risk information resulted in faster response times and resource allocations that were closer to optimal. In FY05, provide solutions for identification and fusion of information necessary to make and control decisions from generally distributed and disparate databases with varied data uncertainties. In FY06, will integrate advanced haptic (touch) displays into a multi-modal test bed and evaluate effect on soldier performance. In FY07, will integrate capability for multinational, multilingual communication in stability and support test bed.	1584	1578	1675	1776

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Auto-adaptive information presentation: investigate how to make autonomous machines team players with their human partners or supervisors in warfighting operations. In FY04, investigated prototype human robotic displays and devised a set of concepts for improved remote perception which enable human perceptual capabilities to assist in guiding the path of a robot in search and rescue operations. Initiated agile computing concepts to enable management of sensor data feeds in distributed sensor networks. In FY05, validate baseline system for improving the flexibility of FCS through dynamically reconfigurable software agent systems. In FY06, will validate test bed for multi-modal information exchange and dynamic adaptation. In FY07, will extend software agent systems to provide an agile computing infrastructure for Unit of Action. Will validate architecture for simplifying Soldier adaptation to new display technologies.	1019	964	1023	1084
Totals	5988	5852	6203	6578

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H59	UNIV CENTERS OF EXCEL	20665	6286	1864	1923	1973	2009	2049	2090

A. Mission Description and Budget Item Justification: Army Centers of Excellence 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. In FY04, this project supported the Rotorcraft Center of Excellence and 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. Also supported in FY04 were five Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) Centers of Excellence for Battlefield Capability Enhancements, the Institute for Collaborative Biotechnologies and the Collaborative Technology Alliance in Robotics. These three efforts were restructured in FY05 from H59 to Projects H04, H05 and H09, respectively, for increased visibility and management oversight. Starting in FY06, the eCYBERMISSION effort will be restructured to Project J14 for increased visibility and management oversight, leaving the Rotorcraft Center of Excellence as the only program funded in this project in FY06 and 07. In FY06 and FY07, this project supports 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 Aviation and Missile Research, Development, and Engineering Center (AMRDEC).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
eCYBERMISSION national competition to stimulate interest in science, math and technology in middle and high school students. In FY04, conducted full-scale launch of 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, nearly doubling participation to include 5,854 students in 1,624 completed teams. In FY 05, sustain eCYBERMISSION and implement enhancements as necessary based on previous years' lessons learned and expand student and teacher participation beyond the results of FY04. In FY06, this effort will be restructured into PE 0601104A Project J14 for increased visibility and management oversight.	4989	4531	0	0
In FY04, established five HBCU/MI Centers of Excellence for Battlefield Capability Enhancements. The centers' focus areas are Sensor Fusion; Lines of Sight/Beyond Line of Sight Lethality, Flexible Extremities Protection; Mounted/Dismounted Maneuver; Human Engineering research in Cognitive Strategies: “Sense Making”. Each center is establishing a close collaborative working relationship with one or more TRADOC Battlelab, industry and Army labs. The Battlelabs are providing a hands-on real-world operational perspective to the centers’ researchers. In FY05, this effort has been restructured into PE 0601104 Project H04 for increased visibility and management oversight.	2385	0	0	0
Robotics Collaborative Technology Alliance: Explore new opportunities to enable revolutionary autonomous mobility for the Future Force. Research conducted as an integral part of the larger Army Robotics Program. In FY04, conducted research in advanced sensors for autonomous mobility, modeling of human-robot interaction, and creation of tools for the analysis of robotic vehicle survivability. In FY05, this effort has been restructured into PE 0601104A Project H09 for increased visibility and management oversight.	2385	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Institute for Collaborative Biotechnologies: Conduct biologically inspired research in sensors, electronics and information processing. In FY04, devised DNA sensing and authentication technique in which DNA detection is read directly as an electronic signal; incorporated recombinant virus protein-directed synthesis of semiconductor nanowires into functional electronic circuits; extended protein-based low-temperature catalysis of synthesis and nanostructural control of semi-conductors using protein discovered responsible for bio-nanofabrication with silica; advanced cell-display and selection technology resulting in a system with unprecedented high-throughput selection; formulated realistic biological reduced order model for the bacterial heat shock response where generalization enables first step comprehensive quantitative analysis of networks and their control in living cells. In FY05, this effort has been restructured into PE0601104A Project H05 for increased visibility and management oversight.	7596	0	0	0
Rotorcraft Centers of Excellence. In FY04, investigated elastically tailored smart composite rotor blades. Investigated innovative design, and conducted fundamental analysis of micro-rotorcraft and Unmanned Aerial Vehicles (UAVs). Devised a smart materials based actively conformable rotor airfoil. Investigated passive and semi-active reduction concepts of gearbox vibration and noise. Investigated active rotorcraft blade tip concepts for tip vortex core modifications using smart structures. In FY05, investigate limit detection and limit avoidance methods for carefree maneuvering. Devise experimental and computational analysis capabilities on rotor wakes and tip vortices. In FY06, will develop active flow control concepts for improving rotorcraft performance and reducing noise and vibratory loads; will investigate advanced adaptive flight control systems and autonomous control functionality; will investigate low Reynolds number aerodynamics for small UAV design analysis; and will develop advanced concepts for rotorcraft UAV systems. In FY07, will investigate high-lift airfoil concepts for delaying dynamic stall onset and reducing adverse pitching moments; will develop data fusion and biomimetic materials for rotorcraft health monitoring systems; 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.	1865	1755	1864	1923
Army Centers of Excellence. The purpose of this one year Congressional add is to fund basic research in cooperation with TRADOC Battle Laboratories. No additional funding is required to complete this project.	1445	0	0	0
Totals	20665	6286	1864	1923

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H62	ELECTROMECH/HYPER PHYS	5653	5357	5792	6126	6233	6329	6454	6582

A. Mission Description and Budget Item Justification: This project funds Army basic research in electromechanics and hypervelocity physics relating to electromechanical components (electromagnetic launchers and power supplies) for applications to electromagnetic (EM) guns. Additionally, this project provides for research, evaluation and computer modeling of advanced hypervelocity projectiles. This project funds a University Affiliated Research Center, the Institute for Advanced Technology (IAT), at the University of Texas. In keeping with the Army EM Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power, materials and techniques to achieve extended rail life, and on establishing the utility of hypervelocity projectiles. This project will research underpinning technologies for EM gun pulsed power; address technical barriers associated with EM gun launch; and research 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 2004	FY 2005	FY 2006	FY 2007
- Pulsed Power: In FY04, devised parametric model of EM pulsed power system and established feasibility of high power Silicon Carbide (SiC) switches. In FY05, include thermal effects in model; analyze constitutive behavior of candidate materials in short EM pulse testers; and mature advanced topology SiC switches. In FY06, will conduct component material experiments and mature a parallel SiC switch module. In FY07, will model electromagnetic, mechanical and thermal properties of candidate EM pulsed power systems.	2046	2089	2200	2355
- Launch: In FY04, established performance of non-transitioning EM launchers and armatures and investigated improved materials to solve technical barriers to EM launch. In FY05, investigate novel, high efficiency launcher configurations and develop model of sliding electric contact. In FY06, will incorporate launcher model into pulsed power model. In FY07, will show long-life, multi-shot EM launcher operation.	1507	1232	1492	1457
- Electromagnetic Lethality: In FY04, matured and evaluated a robust novel kinetic energy penetrator (NKEP) against one half scale heavy armor targets. In FY05, evaluate concepts for enhanced behind-armor debris and evaluate against full-scale targets. In FY06, will flight test complete NKEP and incorporate NKEP into half-scale launch package for EM launch. In FY07, will prove NKEP launch from full-scale EM launcher.	2100	2036	2100	2314

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Totals	5653	5357	5792	6126

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H64	MATERIALS CENTER	2816	3076	2464	2664	2730	2790	2845	2901

A. Mission Description and Budget Item Justification: This project concentrates scientific resources on research to advance innovative materials technologies and exploit breakthroughs in materials science and engineering through Materials Cooperative Research Agreements (MCRAs). MCRAs promote long-term synergistic collaboration between the Army Research Laboratory (ARL), scientists and university researchers. The MCRAs provide for mutual exchange of personnel and sharing of research facilities with U. Delaware, Johns Hopkins U., Rutgers U., and U. Massachusetts. The MCRAs focus research on armor, anti-armor, personnel protection, ground vehicle, rotorcraft and tactical missile applications. Lightweight, multi-functional composites, advanced armor ceramics, bulk amorphous metals, nanomaterials technology, and new polymer hybrid materials for flexible extremities (combat warrior) protection are emphasized. Closely coordinated with ARL in-house materials research projects (PE 0601102A, Project H42), this effort enables the effective and efficient transfer of fundamental scientific research to address requirements for the Future Force. The center accelerates the transition of technology to PE 0602105 (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 2004	FY 2005	FY 2006	FY 2007
In FY04, devised techniques to exhibit multifunctional capabilities in structural composite materials and showed concepts for embedded self-healing, electrical, optical, and power-generating properties in polymer composite materials for Future Force platform survivability; devised theory and design criteria for generating hierarchical hybrid polymer materials using directed self-assembly methods; and devised processing of nano-scale metallics and ceramics envisioned for use in the Future Force. In FY05, devise electro-optical composite structural materials; explore practical strategies to scale-up synthesis and processing of hierarchical polymers and polymer-inorganic hybrid materials; and devise physics based models to predict the effects of microstructure on the behavior of metallic and ceramic material systems under dynamic loading conditions. In FY06, will characterize fundamental behavior of multifunctional composite materials; will devise materials concepts that utilize self-assembly methods to produce polymers, fibers, or coatings with unprecedented properties; and will validate physics based models to predict the effects of microstructure on inorganic materials systems. In FY07, will devise appropriate physics based models that describe the attributes of multifunctional materials; will determine the fundamental response of hierarchical polymer based materials; will devise new inorganic materials that incorporate microstructures designed for specific armor related properties.	2020	2250	2464	2664
Composite Materials Research. The objective of this Congressional Add is to perform composite materials research. In FY04, matured energy storage materials and explored options for incorporation into load bearing structures. In FY05, advance the fundamental composite materials research ongoing at the University of Delaware. No additional funding is required to complete this project.	796	826	0	0
Totals	2816	3076	2464	2664

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H65**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H65	MICROELECTRONICS CTR	936	897	946	1051	1078	1101	1123	1145

A. Mission Description and Budget Item Justification: This project conducts basic research in the area of semiconductor electronics which have broad application to many enduring Army requirements, including power and energy (from soldier micro power to high power high temperature electronics for electric vehicles), prognostics and diagnostics, networked microsensors, radio frequency electronics for secure communications, chemical-biological detection and electro-optical sensing. The benefits and impact to the Warfighter will be to provide basic semiconductor electronics research to support the required electronics for future army applications - both mounted and dismounted. This includes the research to support cost effective, smaller, lighter weight semiconductor electronics that can operate in harsh environments with increased reliability. This basic research effort is conducted through a cooperative agreement between the U.S. Army Research Laboratory and academia, which includes: (1) basic research projects pairing an Army Research Laboratory principal investigator and a principal investigator from academia; (2) the undergraduate student education program, which brings in high quality students to learn the principles of basic research; and (3) a graduate fellowship program. This agreement funds academics to solve current technical barriers and cultivates future talent. Technical barriers include: (1) identifying, understanding and resolving materials defects that can dramatically affect device performance; (2) identifying appropriate materials candidates and device designs in order to investigate devices that can operate under a variety of harsh conditions required by military applications, such as, high power, high temperature, intense vibration and corrosive environments; and (3) scaling issues associated with shrinking device sizes from the macro scale to the micro/nano scale. This project will serve to enhance the survivability, lethality, and mobility, while reducing logistics, of future Army platforms. This center accelerates the transition microelectronics technology to PE 0602705(Electronics and Electronic Devices). 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).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H65**

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- The objective of this effort is to conduct basic research in the area of semiconductor electronics & micro/nano electronics. The research supports future army applications and requirements for electronics that are cost effective, smaller, lighter, and that can operate under realistic military environments including high temperature, high power, intense vibration and corrosion while increasing reliability, enabling future army applications to meet the demands of a lighter weight force with increased/improved capabilities. In FY04, investigated a boron/nitride annealing cap to enable the fabrication of an improved functional Junction Barrier Schottky (JBS) diode for high temperature and power operation; this device has been transitioned to the Power and Energy Collaborative Technology Alliance. In FY05, investigate dielectric materials compatible with silicon carbide (SiC) along with process development techniques in order to develop SiC (Silicon Carbide) based power devices that operate at high temperatures (300 degrees Celsius and above). Model 6H and 4H MOSFETS (metal oxide semiconductor field effect transistor) and MISFETS (metal insulator field effect transistor) for high temperature/high power applications required by all hybrid- electric vehicles. In FY06, will investigate applications of focused ion beam nanofabrication and other nanofabrication techniques to novel devices for general applicability to a wide array of required Army nanoscale electronic devices. In FY07, will investigate semiconducting carbon nanotubes for terahertz (THz) device operation.	936	897	946	1051
Totals	936	897	946	1051

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H73	NAT AUTO CENTER	7840	7422	2958	3074	3191	3233	3261	3286

A. Mission Description and Budget Item Justification: 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 U.S. 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 leap-ahead 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 leap-ahead technologies. Efforts are fully coordinated and complementary to those performed by the NAC and TARDEC under 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 U.S. automotive manufacturers and suppliers. Automotive Research Center (ARC) formulates and evaluates advanced automotive technologies relative to the future FCS vehicular platforms. This effort advances state-of-the-art modeling and simulation for the Army's automotive technologies, with strong emphasis on the Army's FCS 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 Basic Research Plan (BRP). Work in this project is performed by TARDEC, Warren, MI.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Automotive Research Center (ARC): In FY04, completed optimization of the Army's ground vehicle simulation network and implemented a mathematical framework capable of accepting modular subroutines in all generic automotive areas; evaluated and analyzed systems for intelligent remote monitoring, guidance, and controls used for unmanned autonomous and semi-autonomous FCS ground vehicles; integrated newly matured advanced automotive technology algorithms within the overall simulation network. In FY05, evaluate and analyze models suitable for ground vehicle design decisions relative to collision avoidance warning systems, rollover warning, active yaw control, path departure, wireless intelligence systems, and advanced propulsion systems. In FY06, will formulate and analyze modeling and simulation tools relating to systems engineering of advanced and alternative energy powered ground vehicles, improved vehicle fuel economy, reduced visual signature, pollutant emissions through the use of advanced diesel and hybrid power trains, fuel cell auxiliary power units, and lightweight material structures; will evaluate 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, will 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.	2927	2870	2958	3074
University Based Automotive Research. This one year Congressional add developed modeling and simulation tools that leveraged commercial technologies for potential application in Army vehicle systems through on-going and new programs in automotive research. No additional funds are required to complete this project.	2023	0	0	0
TACOM Automotive Research Center University Research. This one year Congressional add focused on developing modeling and simulation tools for alternative propulsion systems leveraging commercial technologies for potential application in Army vehicle systems. No additional funds are required to complete this project.	2890	0	0	0
University Based Automotive Research. This one year Congressional add is to develop modeling and simulation tools for military ground vehicles. No additional funds are required to complete this project.	0	3594	0	0
Partnership for the Next Generation of Vehicles / TACOM: This one-year Congressional add will perform fundamental research that may improve the fuel economy in the Army's current and future fleet of ground vehicles. No additional funds are required to complete this project.	0	958	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Totals	7840	7422	2958	3074

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	11655	10582	7184	7315	7543	7757	7911	8068

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 will serve 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 capabilities 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, the types 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Conduct basic research in immersive environments, to include virtual humans, three dimensional (3D) sound and visual media, to achieve more efficient and affordable training and 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 FY04, completed the specification of algorithms and architecture constructs for the proof of concept test beds and addressed computational efficiency and stability issues, devised new techniques to enhancing the immersiveness of the prototypes. In FY05, investigate hardware and software solutions to timing and processing of multimodal, synchronized, queued media in synthetic environments, including blending virtual and physical objects into the mixed reality aspects of the test beds. In FY 06, will explore the computational hardware and software approaches for representing the immersive environment using holographic imaging techniques. In FY 07, will investigate the timing, synchronization and rendering techniques for augmenting the test beds with holographic imagery.	5534	5653	2800	2849
-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 FY04, devised computationally efficient techniques for applying global illumination to synthetic objects; and extended research into second order effects of natural lighting on real persons in synthetic environments. In FY05, explore techniques for the sonification (using sound, alone or in combination with visual imaging techniques) of data; investigate the recovery of shape and reflectivity for highly reflective objects, and investigate sound as a source of emotion in an immersive environment. In FY 06, will explore Multiview Object and Imaging techniques; and will examine sound cancellation techniques to improve auditory cues in noisy environments. In FY 07, will investigate the concept of generalized reciprocity as it relates to how objects transform incident illumination into reflected light; and will extend the concept of virtual loudspeakers to address multiple participants in a given mixed reality setting.	2616	2427	1645	1675

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Conduct research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness. In FY04, completed draft specification of data elements and parameters to permit synchronized verbal communications techniques for virtual characters to interact with soldiers in education and training situations; and conducted research on the impact that modeling the emotional aspects of verbal and non-verbal communications for virtual humans will have on interaction with human participants. In FY05, complete draft specification of data elements and parameters for non-verbal communications techniques; and integrate emotional models and timing constraints into the draft specification. In FY 06, will investigate an intelligent agent architecture concept that accounts for the emotional models, cultural/ethnic impact on verbal and non-verbal communication, synchronized verbal communications techniques and human – virtual human interaction. In FY07, will explore a conceptual framework for intelligent agents to enable adaptation of the environment based on human and virtual human interactions.	3505	2502	2739	2791
Totals	11655	10582	7184	7315

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J09**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5732	5498	5646	5739	5884	6016	6136	6257

A. Mission Description and Budget Item Justification: This project supports the Collaborative Technology Alliance (CTA) in Power and Energy Technologies. This CTA is a long-term collaboration between the Army Research Laboratory (ARL) and a competitively selected industry/university consortium for the purpose of leveraging world-class commercial research relevant to Army needs. Power and energy research supports lightweight, compact power for the individual soldier, and energy conversion and control technologies for advanced electric mobility, survivability, and lethality applications - such as hybrid electric drive, electromagnetic armor, and electro-thermal-chemical gun – for fuel efficient Future Force Systems including manned and unmanned platforms. Technical barriers include overcoming energy density limitations of traditional electrochemical portable power sources, reforming logistics fuels to generate fuel for fuel cells, and reducing the size and weight of electric power components and systems. The CTA focuses on three main technical areas: portable compact power sources (non-electrochemical), fuel cells and fuel reforming, and hybrid electric propulsion and pulsed power for survivability and lethality. These technologies are fundamental elements required to realize the Army Transformation and support the Future Force. The research in pulsed power and hybrid electric is done in coordination with the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC). 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. Work in this CTA accelerates the transition of technology to PE 0602705 (Electronics and Electronic Devices). 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 Lab (ARL).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J09**

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Research, investigation and characterization of a micro electro mechanical system (MEMS) based micro-gas turbine generator for producing electricity for the dismounted soldier of the Future Force. In FY04, designed 2nd generation engine with non-magnetic generator and turbine film cooling. In FY05, complete demo engine design, begin engine fabrication, and validate magnetic generator. In FY06, will prove first MEMS micro-gas turbine engine. In FY07, will validate MEMS micro-gas turbine engine generator operating with net electrical power output.	2207	2144	2202	2246
- Research, investigation and characterization of novel fuel cells/components and logistic fuel reformation techniques to produce electricity for the dismounted soldiers of the Future Force, as well as produce electricity for vehicle prime power and accessory power for the Future Combat System. In FY04, matured a 20-watt fuel cell using reformed-methanol as fuel for Soldier Power applications. In FY05, integrate a catalytic partial oxidation fuel reformer with a solid oxide fuel cell designed to operate with partially reformed logistics fuels for vehicle and robotic platforms, and prove in test rig. In FY06, will validate a compact direct methanol fueled 20W cell with improved performance over current state of the art. In FY07, will validate a 'benchtop' solid oxide fuel cell operating on Army Logistics fuel without the addition of water.	3525	3354	3444	3493
Totals	5732	5498	5646	5739

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J12	NANOTECHNOLOGY	9446	9097	9933	10278	10535	10769	10983	11201

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) laboratories 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. Computational models will be created that predict the Soldier's performance with the new technologies. 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 ARL and by visiting RDECOM scientists.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Conduct research in nano-based multifunctional materials for Soldier protection. In FY04, characterized new molecular architectures with promising energy absorbing properties for lighter-weight ballistic protection. In FY05, devise innovative processes and techniques to construct high performance layered structures to provide multifunctionality, including waterproofing, microbicidal protection, and sensing, for light-weight fabrics and non-woven materials to improve Soldier protection. In FY06, will create hierarchical structures which demonstrate a range of material properties and improved protection against various Soldier threats. In FY07, will provide materials for evaluation that have improved survivability capabilities with nano-tailored surfaces, to provide capabilities such as nutrient delivery, water harvesting, and moisture repellency.	1723	1868	2040	2111
- Conduct research in nano-structured polymer actuators to improve Soldier performance. In FY04 integrated high-power, high-force nanostructured polymer actuator materials and sensors into materials to improve the force achievable by human muscle to enable the Soldier to perform at higher physical levels. In FY05, explore biomimetic muscular and structural behavior with potential to provide new approaches to outperform natural systems. In FY06, will characterize elastomeric, electrical and mechanical properties experimentally and with advanced modeling and simulation. In FY07, will create prototype hierarchical structures that deflect strains and stresses resulting from environmental and man-made threats while also providing improved performance.	3389	3711	4052	4192
- Conduct research on integration, fabrication and modeling of nano-structured materials to create mechanically-active devices and sensors. In FY04, characterized new liquid crystal block copolymers and conducting polymers for actuating materials for ballistic protection and on-demand medical intervention; incorporated semiconductor nanoparticles into ultra-thin polymer films for decontaminating toxic materials; carried out novel chemistry on common textiles to make them antibacterial; and characterized viral arrays on surfaces that may be used to detect chemical and biological materials. In FY05, integrate new measurement and characterization research, including femtosecond laser characterization; and demonstrate and enhance innovative methodologies to transition breakthroughs to Army labs/centers and industrial partners. In FY06, will begin fabrication of model systems of two or more nano-components to provide useful macro capabilities; and will use modeling and simulation to advance systems architecture for integrating multiple, nano-enabled survivability capabilities into Soldier systems. In FY07, will integrate subassemblies into larger assemblies to assess potential benefit for improved survivability.	4334	3518	3841	3975

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Totals	9446	9097	9933	10278

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J14	ECYBERMISSION	0	0	4809	4963	5091	5184	5287	5392

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 is a restructuring of ongoing research into a distinct project for increased visibility and management oversight

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- In FY04 and FY05, this effort was funded in this PE under Project H59. eCYBERMISSION national competition to stimulate interest in science, math and technology in middle and high school students. In FY06, will continue 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 increasing student and teacher participation beyond the results of FY05. In FY07, sustain eCYBERMISSION and implement enhancements as necessary based on previous years' lessons learned.	0	0	4809	4963
Totals	0	0	4809	4963

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	0	0	5000	6119	7146	8169	8167	8166

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 collaborative fundamental research on topics relevant to US/UK military requirements. The US Army Research Laboratory (ARL) and the UK Ministry of Defense (MOD) will establish a jointly funded and managed US and UK consortium, to be known as an International Technology Alliance (ITA) on Network and Information Sciences. The goal is fundamental science breakthroughs to enable superior coalition operations. Emphasis is on integration of multiple technical disciplines in an international arena. The "Network and Information Sciences" scope includes basic research into sensors exploitation, human dimension, and networking technologies. 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 by the Army Research Laboratory.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Network & Information Sciences ITA: Perform research into fundamental scientific underpinnings and theory for application to network and information science in the areas of network theory, security across a system of systems, sensor processing and information exploitation, and distributed coalition planning and decision making. In FY06, will award a competitive procurement establishing the US/UK International Technology Alliance in Network and Information Sciences for fundamental research into sensors exploitation, human dimension (distributed coalition decision-making), and networking technologies. In FY07, will conduct analytical and experimental studies in network theory and the interaction of networks, information exploitation and distributed decision making.	0	0	5000	6119
Totals	0	0	5000	6119

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601105A - Force Health Protection

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		15969	22319	0	0	0	0	0	0
D52	FORCE HEALTH PROTECTION	9446	9138	0	0	0	0	0	0
D56	GULF WAR ILLNESS RESEARCH (CA)	2014	5752	0	0	0	0	0	0
D57	MEMS FOR DEFENSE APPLICATIONS AND NANOTECHNOLOGY	4509	0	0	0	0	0	0	0
D59	ALS THERAPY DEVELOPMENT FOR GULF WAR RESEARCH (CA)	0	1917	0	0	0	0	0	0
D60	BIOMEDICAL ENGINEERING INITIATIVE (CA)	0	1438	0	0	0	0	0	0
D61	RURAL HEALTH CENTER (CA)	0	4074	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: In FY04, OSD funds were transferred to the Army under Force Health Protection Research. Force Health Protection Research seeks to enhance protection of Service members against health threats in military deployments both by increasing our understanding of military health issues and by applying findings from a decade of research on the etiology (cause and origin of disease) and treatment of Gulf War Illnesses (GWI). This program is conducted in close coordination with the Department of Veterans Affairs. The program is divided into five thrust areas: (1) global health monitoring; (2) health behavior interventions; (3) health risk communication; (4) health risk assessment methods; and (5) medical materiel safety. This project 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 in this PE is performed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA.; the Naval Health Research Center, San Diego, CA; and the U.S. Army Center for Environmental Health Research, Fort Detrick, MD.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	9538	9680	10367
Current Budget (FY 2006/2007 PB)	22319	0	0
Total Adjustments	12781	-9680	-10367
Net of Program/Database Changes			
Congressional Program Reductions	-329		
Congressional Rescissions			
Congressional Increases	13750		
Reprogrammings			
SBIR/STTR Transfer	-640		
Adjustments to Budget Years		-9680	-10367

Change Summary Explanation:
FY06 - Funds restructured to PE 0602787A ($7744K) and PE 0603002A ($1936K) for proper program execution in accordance with DoD Financial Management Regulation Budget Activity definition.
FY07 - Funds restructured to PE 0602787A ($8294K) and PE 0603002A ($2073K) for proper program execution in accordance with DoD Financial Management Regulation Budget Activity definition.

Five FY05 Congressional Adds totaling $13750 were added to this PE.

FY05 Congressional Adds with no R-2As:
($1918) ALS Therapy Development for Gulf War Research, Project D59: The purpose of this one year Congressional add is to fund basic research into ALS therapy development for Gulf War Illness. No additional funding is required to complete this project.

($1438) Biomedical Engineering Initiative, Project D60: The purpose of this one year Congressional add is to fund basic research in biomedical engineering. No additional funding is required to complete this project.

($4795) Extramural Gulf War Illness Research on Chronic Physiological Brain Effects (Low Level Chemical Exposure), Project D56: The purpose of this one year Congressional add is to fund basic research on Gulf War Illness. No additional funding is required to complete this project.

($959) Gulf War Illness and Chemical Agent Exposure Program, Project D56: The purpose of this one year Congressional add is to fund basic research into the causes of and cures for Gulf War Illness. No additional funding is required to complete this project.

($4075) Rural Health Center for Remote and Medically Under-Served Areas, D61: The purpose of this one year Congressional add is to fund basic research in rural health centers for remote and medically under-served areas. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602105A - MATERIALS TECHNOLOGY

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	40043	50788	17559	18236	19241	19590	19868	20128
H7B	ADVANCED MATERIALS INITIATIVES (CA)	25420	35758	0	0	0	0	0	0
H7G	NANOMATERIALS APPLIED RESEARCH	0	4555	5006	5193	5323	5469	5577	5688
H84	MATERIALS	14623	10475	12553	13043	13918	14121	14291	14440

A. Mission Description and Budget Item Justification: This program element (PE) researches and evaluates materials technologies for armor and armaments that will significantly enhance the survivability and lethality of Future Combat Systems (FCS) and Future Force systems and, where feasible, can be exploited to enhance Current Force capabilities. The PE builds on the materials research transitioned from PE0601102 (Defense Research Sciences) H42 (Materials and Mechanics) and applies it to specific Army platforms and the individual soldier. Project H84 is directed toward developing materials technology that contributes to making our heavy forces lighter and more deployable, and our light forces more lethal and survivable. It 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 for Technology, MA 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 602782 (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 PE0708045 (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 (ARL) is intended to transition materials technologies and support the Army materiel efforts at the Armaments Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center (TARDEC), Warren, MI; the Aviation and Missile Research, Development and Engineering Center (AMRDEC), 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.

Note: In FY05, the ongoing effort in nanomaterials previously funded in Project H84 has been restructured into a separate project for heightened visibility and management (Project H7G – Nanomaterials Applied Research).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	15385	14701	15464
Current Budget (FY 2006/2007 PB)	50788	17559	18236
Total Adjustments	35403	2858	2772
Net of Program/Database Changes			
Congressional Program Reductions	-739		
Congressional Rescissions			
Congressional Increases	37300		
Reprogrammings			
SBIR/STTR Transfer	-1158		
Adjustments to Budget Years		2858	2772

Change Summary Explanation:
FY06 - Increased funding ($2858K) to enhance Applied Research in Materials including Nanomaterials Technology to improve the survivability and lethality of Future Force systems and where feasible, exploit opportunities to enhance Current Force capabilities including individual soldier protection.
FY07 - Increased funding ($2772K) to enhance Applied Research in Materials including Nanomaterials Technology to improve the survivability and lethality of Future Force systems and where feasible, exploit opportunities to enhance Current Force capabilities including individual soldier protection.

Seventeen FY05 Congressional Adds totaling $37300 were added to this PE.

FY05 Congressional Adds with no R-2A:
Advanced Materials for Mine Detection and Blast Mitigation, Project H7B ($2397)
Advanced Materials Processing for Future Combat Systems, Project H7B ($6712)
Ballistic Shields Program, Project H7B ($959)
Composite Materials Technology for FCS, Project H7B ($1918)

Design and Manufacturing Process Technology for High Performance Polymer Nano-Composites, Project H7B ($1247)
Development of Manufacturing Science for Lightweight Ceramic Armor, Project H7B ($959)
Engineered Surfaces for Weapons Systems Life Extension, Project H7B ($2685)
Future Affordable Multi-Utility (FAMU) Materials, Project H7B ($959)
Future Affordable Multi-Utility (FAMU) Materials for the Army FCS, Project H7B ($1726)
Materials Joining for Army Weapons Systems, Project H7B ($2493)
MEMS Sensors for Rolling Elements Bearings, Project H7B ($1247)
Micro-Laminate Ceramic Armor, Project H7B ($2493)
Molecular Design of Polymer Nanocomposites ($1151)
On-Demand Micro Electronics Manufacturing and Qualification, Project H7B ($1919)
Precision Polishing of Large Optics, Project H7B ($3261)
Tactical Armor Manufacturing Technology, Project H7B ($2685)
Ultrasonic Consolidation Matrix for Metal Composites, Project H7B ($959)

FY05 Congressional Adds and no R-2A are not defined due to space limitations.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H7G	NANOMATERIALS APPLIED RESEARCH	0	4555	5006	5193	5323	5469	5577	5688

A. Mission Description and Budget Item Justification: This project integrates 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 a collaborative research effort in nanomaterials technology between the Army Research Laboratory (ARL), the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology and the ISN's 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).

The work in this project was previously funded in PE 0602105A project H84. In FY2005, a separate project to heighten visibility of the efforts in this important area of material research and focus on improvements in individual soldier protection.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- 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 fabrication into woven materials) to enable revolutionary Future Force Warrior protection capabilities. Coordinated research program conducted internally, by ARL, externally by ISN industry partners, and through collaboration with ARL and ISN industry partners. In FY05, devise protective materials concepts that could be incorporated into multifunctional capabilities (e.g., ballistic, blast and fire/flame protection) with reduced weight within single integrated system. Exploit selected processing methodology to fabricate prototype nanomaterials-based, functionally integrated specimens for evaluation with improved survivability and lethality. In FY06, will investigate materials technologies and incorporate into flexible multi-material assemblies and determine performance of newly developed materials systems. In FY07, will mature multi-functional materials concepts to include addressing scalable processing and fabrication methods.	0	4555	5006	5193
Totals	0	4555	5006	5193

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H84 MATERIALS	14623	10475	12553	13043	13918	14121	14291	14440

A. Mission Description and Budget Item Justification: The goal of this project is to provide the technical foundation for materials technology in metals, ceramics, polymers, and composites that are essential for lethal and survivable Future Combat Systems (FCS), Future Force Warrior (FFW) and other Future Force platforms. 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 materials and structures 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, mechanics, 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 the 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 FCS and FFW. The work is conducted by the Army Research Laboratory (ARL), 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 (ARDEC), Picatinny Arsenal, NJ; the Tank and Automotive Research, Development and Engineering Center (TARDEC), Warren, MI; the Aviation and Missile Research, Development and Engineering Center (AMRDEC), 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. In FY04, this project funded the collaborative research effort in nanomaterials technology between the ARL and the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute for Technology, MA. This effort, associated only with nanomaterial research for the specific application of soldier protection, transitions to 0602105A H7G in FY05. 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 2004	FY 2005	FY 2006	FY 2007
- 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 FCS, Current and Future Force Platforms and Ground Tactical Vehicles. In FY04, provided and evaluated improved materials and processes to include multi-spectral and transparent ceramics that increase performance of armor systems; and established computational methodologies for design of blast and impact-resistant multifunctional (e.g., providing combined power, communications, propulsion, or sensory capabilitites) composite structures for enhancement of FCS systems. In FY05, validate enhanced structural armor, metallics, and ceramics to enable advanced armor technology formulation; and validate computational methodologies for design of blast and impact-resistant multifunctional composite structures critical to improving the survivability of Current and Future Force platforms. In FY06, the validated computational models will be used to design and fabricate multi-material assemblies to achieve optimized multi-spectral properties. In FY07, will evaluate these multi-functional assemblies against ballistic, mine blast and other emerging threats.	4209	4201	4223	4631
- Optimize lightweight armor materials and defeat mechanisms against emerging threats to enable affordable design of future multifunctional ballistic protective systems for the Future Warrior. Provide quantitative scientific basis for modeling and simulation that result in new lethal mechanisms/protection schemes for the individual warfighter. In FY04, optimized lightweight armor materials and defeat mechanisms against emerging threats and provided prototype armors to the Natick Soldier Center that incorporated advanced processing techniques enabling affordable design of future multifunctional ballistic protective systems for the Future Force Warrior. In FY05, devise new physics-based simulation capability to model the effects of ballistic, blast, or shock impact and stab incidence on the warfighter; investigate novel armor materials and processing techniques to devise concepts for soldier extremities protection. In FY06, will exercise initial simulation codes against known threats and current protection schemes and refine models as required; will incorporate lightweight armor materials and novel defeat mechanisms into concepts to improve Soldier extremity protection. In FY07, will validate simulation and design tools for individual warfighter protection and lethality applications and transition promising protection/lethality concepts to development community.	1566	2251	2434	2467

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Design, validate, and optimize advanced materials (ceramic, composite, polymers, lightweight and high metals) and processing techniques for smaller but more lethal penetrators/warheads and affordable, lightweight high performance armaments for revolutionary Future Force lethality. In FY04, characterized failure mechanisms in emerging anti-armor materials and investigated effects of processing variables and constituents for improved design of penetrators/warheads; showed thermally robust sheathing techniques capable of inducing a multi-axial compressive stress to insure structural integrity of sheathed ceramics subjected to internal pressure loading to enable improved armaments for the Future Force. In FY05, transition improved ceramic gun barrel technology to ARDEC/AMRDEC, and produce sub scale penetrators from emerging amorphous metals and unique alloys. In FY06, will characterize full scale penetrators and provide alloy/penetrator manufacturing process diagrams for production and transition to industrial partners; will investigate behavior of metal matrix composites subjected to tensile load over the range of operational temperatures typical for cannons. In FY07, will mature processes and techniques for fabricating ultra-fine grain materials that result in penetrators with improved strength and stiffness; will identify and prove out a process for application of an erosion-resistant appliqué on a lightweight composite cylinder to enable future lightweight armaments.	3705	3523	3449	3480
- 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 FCS and Future Force platforms. In FY04, successfully integrated Barium Strontium Titanate (BST) with a thin layer on silicon substrates, using deposition and integration parameters that yielded optimum device material properties, that can be processed in silicon wafer foundaries, thereby significantly reducing the cost and improving the device yield. In FY05, transition materials technology to CERDEC for incorporation into devices. In FY06, will establish life testing methodologies to evaluate reliability of thin film-based structures. In FY07, will investigate novel materials concepts to increase the temperature stability of active thin film materials.	500	500	500	500

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- 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 fabrication into woven materials) to enable revolutionary Future Force Warrior protection capabilities. Coordinated research program is conducted internally, by ARL, externally by ISN Industry Partners, and through collaboration with ARL and ISN Industry Partners. In FY04, designed and devised scalable processing/synthesis methods and showed improved physics-based materials property models applicable for soldier protection concepts. In FY05, Project H7G has been initiated to provide a clear and focused effort for nanotechnology as it relates to individual soldier protection.	4643	0	0	0
- 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 H7G. In FY06, will devise nanomaterial concepts to produce lightweight transparent structural materials systems; mature processing methods to produce nanometallic materials; validate nanomaterial enhancements to improve structural and impact properties of polymer composite materials; devise nanomaterial additives for use in military coatings system improvements; and mature unique experimental and numerical methods to characterize the mechanical response of nanomaterials. In FY07, will mature 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.	0	0	1947	1965
Totals	14623	10475	12553	13043

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602120A - Sensors and Electronic Survivability

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		28897	38433	32147	36102	37751	39174	39581	39945
140	HI-POWER MICROWAVE TEC	2784	2949	4999	5602	6246	6263	6318	6364
H15	GROUND COMBAT ID TECH	8411	4604	5606	5728	5940	7785	7853	7911
H16	S3I TECHNOLOGY	14488	14869	17891	19177	20091	19408	19578	19723
SA1	SENSORS AND ELECTRONIC INITIATIVES (CA)	3214	7908	0	0	0	0	0	0
SA2	BIOTECHNOLOGY APPLIED RESEARCH	0	2639	3651	5595	5474	5718	5832	5947
SA3	COMBAT IDENTIFICATION COMPONENT TECHNOLOGIES (CA)	0	5464	0	0	0	0	0	0

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 Combat Systems (FCS) and 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), and fire control systems, as well as the fuzing and guidance-integrated fuzing functions in future munitions; and significantly improving the survivability, lethality, deployability, and sustainability of FCS by devising high-power electronic components and technologies for compact, light-weight power and energy storage, conversion and conditioning, and radio frequency (RF)-microwave directed energy (RF-DE) weapons. Project 140 researches, develops, and evaluates Radio Frequency Weapon technology, as well as high power components. Project H15 will provide the ability for joint fires to locate, identify, track, and engage targets as necessary with over all goal of increasing lethality and survivability through the reduction of fratricide. Project H16 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 Institute for Collaborative Biotechnology (ICB) industry partners will conduct applied research focused on biological sensors and biological photovoltaics for power generation. Work in SA2 will exploit breakthroughs in biotechnology basic research transitioning from the ICB, a University Affiliated Research Center, to enable revolutionary Future Force capabilities in sensors, electronics and photonics. Projects SA1 and SA3 fund Congressional special interest items. Work in this 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), and PE 0603008 (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 is performed by the Army Research Laboratory (ARL) and the Communications-Electronics Research, Development, and Engineering Center, Ft. Monmouth, NJ.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	25629	31703	34843
Current Budget (FY 2006/2007 PB)	38433	32147	36102
Total Adjustments	12804	444	1259
Net of Program/Database Changes			
Congressional Program Reductions	-513		
Congressional Rescissions			
Congressional Increases	13950		
Reprogrammings			
SBIR/STTR Transfer	-633		
Adjustments to Budget Years		444	1259

Change Summary Explanation:

Five FY05 Congressional Adds totaling $13950 were added to this PE.

FY05 Congressional Adds with no R-2A:
($4028) Digital Radio Frequency Tags (DraFT), Project SA3: The purpose of this one year Congressional add is to fund research on a low cost “chip” implementation approach for radio frequency tag design. No additional funding is required to complete this project.

($1438) Disposable Sensors for Battlefield and Urban Warfare, Project SA1: The purpose of this one year Congressional add is to fund research on disposable sensors for use on the battlefield and in urban warfare. No additional funding is required to complete this project.

($4795) Optical Combat Identification System Prototype Development and Testing, Project SA3: The purpose of this Congressional add is to research develop an optical combat identification prototype for development and testing. No additional funding is required to complete this project.

($1678) Portable Chemical-Biological Agent Detection System, Project SA1: The purpose of this one year Congressional add is to fund research on

technologies to develop a portable chemical-biological agent detection system. No additional funding is required to complete this project.

($1438) Small Airship Surveillance System-Lite Remotely Piloted System, Project SA1: The purpose of this one year Congressional add is to fund research in small airship surveillance systems. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
140	HI-POWER MICROWAVE TEC	2784	2949	4999	5602	6246	6263	6318	6364

A. Mission Description and Budget Item Justification: This project researches, develops and evaluates Radio Frequency (RF) Directed Energy Weapon (DEW) technology, as well as high power components that will significantly enhance the survivability and lethality of Future Combat Systems (FCS) platforms and related systems. The DEW effort studies both RF microwave and laser system capabilities and effects against various threats, including electronic off and on route mines, such as improvised explosive devices (IEDs) and electronically guided and fuzed missiles/munitions. Realizing DEW capabilities for diverse targets at a variety of lethality levels and operational ranges on FCS requires optimizing the DEW system and developing compact, high density power systems meeting stringent FCS 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., studying 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 components 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 (ARDEC), and the Communications and Electronics Research, Development and Engineering Center (CERDEC).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Research and mature high power converters and enabling technology, such as high-temperature devices to achieve high-power and temperature operation for high power demand capabilities, including DEW, while meeting the stringent weight/volume requirements for FCS and related platforms for the Future Force. In FY04, demonstrated a 10 kW Silicon (Si) modified matrix converter (MMC) (400 Hz input frequency) in a generator-set with variable motor control that is fault-tolerant to unbalanced loads; scaled MMC power modules to FCS power levels for direct current – alternating current (DC-AC) conversion for motor control; implemented next-generation digital signal processor and control software for MMC power modules for high-efficiency low –interference power converters. In FY05, investigate and mature high-temperature silicon carbide (SiC) power modules for >50 kW-level power conversion at 150 degrees Celsius (C) for motor control, for vehicle power bus and for vehicle survivability and lethality systems. In FY06, will investigate and mature high-temperature SiC power modules for > 100 kW-level power conversion at 150 C for motor control, for vehicle power bus and for vehicle survivability and lethality systems. In FY07, will investigate and demonstrate high-temperature SiC power modules for >200kW level power conversion at 150 C for motor control, for vehicle power bus and for vehicle survivability and lethality. This is in support of TARDEC work on power generation, conditioning and control for hybrid electric vehicle and pulse power for Future Combat Systems.	1697	1395	1381	1156
- Research and mature novel solid-state laser concepts, architectures and design components enabling High Energy Laser (HEL) Technology for Army-specific Directed Energy Weapon applications. Exploit breakthroughs in laser technology and photonics basic research to meet the stringent weight/volume requirements for FCS and related platforms for the Future Force. In FY06, will investigate and mature the most promising laser ceramic materials for efficiency and effects, while fostering on-shore material development; design and breadboard efficient high-power laser based on highly concentrated neodymium-doped yttrium aluminum garnet (Nd:YAG) ceramics while implementing the latest in diamond-cooling technologies for advanced thermal management and beam quality improvement. In FY07, will investigate and demonstrate efficient, ultra-low-quantum-defect, high power “eye-safe” laser (~1.5 mm) with direct diode pumping by the most advanced long-wavelength laser diodes and show correlation between predicted and measured effects on target materials. Applied research will be conducted by ARL in close collaboration with domestic ceramic (and other) material vendors and laser diode manufacturers.	0	0	1461	1970

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- 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 Future Combat Systems platforms. In FY04, initiated efforts to develop EW techniques for countering/defeating improvised explosive devices (IEDs); investigated RF effects on surrogate IEDs and booby traps; designed the IED Countermeasure Equipment (ICE) concept to stay abreast of the evolving and diverse IED threat; investigated RF effects on threat anti tank guided missiles and measured levels to produce guidance errors in support of the Agile Target Effects System demonstration; matured power requirements for RF DE based counter-IED concept for off-route mine detection and neutralization; fabricated a prototype ICE device that underwent developmental testing, interoperability, and operational testing against threat devices. In FY05, investigate RF DE effects on off-route mines, measure power/modulation needed to produce effects, and provide to CERDEC/ARDEC; design breadboard counter-IED neutralization demonstrator and evaluate in lab/ field test; verify/update RF coupling algorithms in Directed RF assessment model for Joint Aircraft Survivability Program Office. In FY06, will design and develop a man-portable version of ICE; will investigate RF effects on off-route mines; will investigate effects on Side Attack Mines of interest; will measure power/modulation levels required to dud and/or pre-fire; and will design and fabricate counter off-route mine neutralization demonstrator and prove principle in lab/ field test. In FY07, will determine RF lethality levels for selected air threats for Air Defense Artillery Center and Space and Missile Defense Command, will transition counter-mine system design to CERDEC and determine power requirements for Enhanced Area Air Defense System and transition system design.	1087	1554	2157	2476
Totals	2784	2949	4999	5602

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H15	GROUND COMBAT ID TECH	8411	4604	5606	5728	5940	7785	7853	7911

A. Mission Description and Budget Item Justification: The objective of this project is to mature and demonstrate emergent combat identification (CID) systems 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, exploits opportunities to enhance Current Force capabilities. This project provides the technologies for the Coalition Combat Identification Advanced Concept Technology Demonstrations (ACTD) that is exploring and demonstrating CID with the UK, France, Germany, Canada, Italy, Sweden, and Australia. The project provides maturation of the enabling technologies to demonstrate common identification standard agreements, reduce weight and cost, and evaluate radio frequency (RF) tags as a CID enabler. This project will set the baseline for the Future Force to enable fratricide reductions through CID concepts to include blue force tracking via RF Tags scanned by synthetic aperture radar/moving target indicator (SAR/MTI) radar. This project increases the survivability and lethality of Coalition Forces by providing a matured capability to identify friend from foe, thereby, reducing fratricide incidents across the battlefield. CID must be software functional, portable across a family of platforms, tied to the future tactical internet, over-the-horizon capable and highly resistant to countermeasures. CID systems must operate successfully in all weather environments and must not be impacted by smoke, fog, dirt and other obscurants. The Future Force CID capability will fuse situational awareness (SA) and Point-of-Engagement Target Identification into a common "through sight" picture. The future CID architecture will necessitate the integration of a network composed of diverse reconnaissance, surveillance and target acquisition (RSTA) sensors that include non-cooperative capabilities in the sensor suites and a cooperative ID capability that will be realized as part of the future network centric, real-time, red and blue SA for both combat vehicles and unit of action/unit of employment (UA/UE) Commander. Coordination will be accomplished with other services, allies and coalition partners. MANPRINT will be addressed in all activities.

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 2004	FY 2005	FY 2006	FY 2007
- Coalition Combat Identification ACTD: In FY04, tested Battlefield Target Identification (BTID) interoperability and Standard NATO Agreement compliance with UK and France at Combined Joint Task Force Exercise (CJFTX)-04;demonstrated Radio Frequency (RF) tags for Fixed Wing Close Air Support; tested ground based Radio-Based Combat Identification (RBCI) at US Army Electronic Proving Grounds (EPG) and Joint Interoperability Test Command (JITC) to insure specification compliance, deployability and interoperability with fielded systems; demonstrated RBCI in CJFTX-04 and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) exercises and prepared RBCI for deployment to Operation Iraqi Freedom (OIF). In FY05, conduct international exercise (US, UK, France, Italy, Germany) using BTID, RBCI and RF tags; test RBCI operating in ASIP SINCGARS with Digital Knee-Board interface, integrated on an Apache and UAV; demonstrate ground based RBCI during the final ACTD operational exercise.	3878	4058	0	0
- Network Centric Combat Identification Technologies: In FY04, evaluated use of Ku and X-band Digital Radio Frequency (RF) tags for Blue Force Tracking and air-to-ground Combat ID (CID). In FY05, conduct operational testing and assess military utility of RF tags in conjunction with Synthetic Aperture Radar/Moving Target Indicator (SAR/MTI) radar to provide passive CID; investigate combat ID technologies for soldier to soldier. In FY06, will develop an integrated approach for a net centric CID architecture including target ID, Situational Awareness (SA) and fusing algorithms; will integrate combat ID waveforms into Joint Tactical Radio System (JTRS) and FCS architectures, and continue RF tag development; will investigate non cooperative target recognition technologies with the Air Force for CID; will develop soldier to soldier CID technology and investigate combat ID technologies for vehicle to soldier CID. In FY07, will develop JTRS based waveforms for CID; will use CID cost effectiveness tools to select promising technologies for ID of foes and neutrals; will mature net centric CID approaches, including soldier to soldier CID and RF tags; will study space based Radar Concept with RF tags.	688	546	5606	5728
- Army Advanced Identification Technology Simulators (AAITS): This one-year Congressional add investigated and designed a CCID ACTD Technology Testbed and a low fidelity simulator. No additional funding is needed to complete this project.	3845	0	0	0
Totals	8411	4604	5606	5728

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H16	S3I TECHNOLOGY	14488	14869	17891	19177	20091	19408	19578	19723

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 Combat Systems (FCS) and other emerging thrusts. The ultimate impact and utility of this work will be to protect our 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 dealing with 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; fusion of diverse sensors such as acoustic, seismic, magnetic, radar, infrared (IR), 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 which 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 will enable buried mine detection and target imaging through dense foliage and will greatly enhance robotic mobility; aided/automatic target recognition (ATR) to allow 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 situation assessment to present a common picture of the battlespace focused on low echelon commanders; advanced information processing methods to provide automatic information technologies which 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 0602709 (Night Vision Technology), PE 0603710 (Night Vision Advanced Technologies), and PE 0603001 (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 2004	FY 2005	FY 2006	FY 2007
- Mature underpinning technologies for low-cost unattended ground sensors (UGS) for homeland defense, counter-terrorism, FCS and the future soldier. Implement and mature advanced passive acoustic/seismic algorithms to detect, track and ID targets for Unmanned Ground System (UGS). In FY04 incorporated acoustic target counting and ID capability into the Army Acoustic Algorithm and evaluated its capability against ground vehicles; matured Unattended Transient Acoustic Measurement & Signal Intelligence (MASINT) System (UTAMS) for mortar launch and impact detection and transitioned prototypes in support of Operation Iraq Freedom (OIF); and designed low-cost magnetic sensor for the Cave and Urban Assault ACTD and the CERDEC Disposable Sensors Program. In FY05, provide mature Army acoustic algorithm to CERDEC for use in Networked Sensors for the Future Force ATD; mature sensor nodes and algorithms and transition to Cave & Urban Assault ACTD. In FY06, will provide mature sensor nodes and algorithms along with Radio Frequency (RF), magnetic, electric field, and acoustic technology required for providing baseline personnel detection capability to CERDEC Disposable Sensors Program. In FY07, will evaluate performance of fusion algorithms at the node level; will devise and mature algorithms for persistent sensing and change detection in urban areas using low cost disposable sensor nodes.	5299	5418	6526	6697

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Research, mature and validate electro-optical techniques and components to detect/identify targets in clutter and to protect sensors and eyes from threat laser sources on the battlefield; mature low cost Laser Detection and Ranging (LADAR) and target recognition techniques for 3rd generation Forward Looking Infrared (FLIR) in support of CERDEC program for FCS sensors; and redesign optical devices and explore new nonlinear optical materials. In FY04, designed and delivered moving target indication (MTI) techniques for different sensors and FCS applications, advanced clutter rejection algorithm for fused uncooled FLIR and active Short Wave IR sensors, and studied fusion techniques at different levels of data abstraction; matured propagation model for nonlinear materials applicable to sensor and eye protection. In FY05, apply MTI algorithms for force protection applications, collect data for devising change detection algorithms, investigate hyperspectral algorithms for target and personnel detection, implement a super-resolution technique for ATR applications, and mature a standard dataset and metrics of synthetic targets for classification algorithms; build, characterize, and evaluate additional components, including mirrors of amalgam composition and/or incorporating Micro Electro Mechanical System structures. In FY06, will investigate advanced force protection concepts and implementations, adapt classification, hyperspectral, and change detection algorithms for various applications, and study the fusion of multi-band IR sensors for target detection; and mature and evaluate magneto-optical switches for fast shuttering of optical systems. In FY07, will design and evaluate fusion algorithms for multi-band IR sensor target detection; integrate and evaluate components devised in the previous years (nonlinear optical materials, sacrificial mirrors, and magneto-optical switches) into a TARDEC-ARL developed brassboard laser hardening system.	1639	2007	3397	4408

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Using models and measurements, determine effectiveness of ultra wideband (UWB) radar for detecting complex obstacles for robotic perception. Assess and remediate image formation artifacts that may limit the potential of UWB Synthetic Aperture Radar (SAR) to detect buried mines. Complete enhanced RF signature measurement and hybrid electromagnetic (EM) modeling capabilities to enable prediction of tactical vehicle signatures through millimeter wave (MMW) frequencies for integrated survivability. Use enhanced models and measurements on tactical vehicles and clutter to produce improved target detection, tracking and classification algorithms for FCS tactical radars. In FY04 devised radar-imaging techniques to determine the value of three dimensional (3D) resolution for detecting obstacles; used facet files generated from Computer Aided Design (CAD) to model an FCS-like vehicle at X-band and Ka-band and assessed accuracy of prediction. In FY05, devise and evaluate physics-based mine detection algorithm for difficult deployments; and evaluate hybrid approaches to model complex targets. In FY06, will evaluate concepts for sharing multiple capabilities such as mine detection and vehicle perception using common hardware and algorithms; and will evaluate error sources at W-band and assess capability to accurately model signatures from vehicle CAD files. In FY07, will devise and evaluate image formation algorithms that take advantage of combined air and ground unmanned platforms; and will mature a unified solver environment to enable accurate prediction of highly complex vehicle shapes and materials through MMW frequencies in the presence of realistic terrain backgrounds.	2488	2528	2778	2643

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Mature multifunction RF and optical interconnects 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 for use on small ground and air vehicles. Mature optical data links and processing architectures to accept massive raw data streams from multiple FCS sensors and efficiently produce real-time battlespace information for commanders and soldiers. Mature models and evaluate networked sensor concepts in support of netted fires to allow dynamic updating of weapons in-flight. In FY04, assessed monopulse tracking errors of kinetic energy penetrators, and advanced active protection waveform for real-time tracking of high speed targets. Validated OE interconnects with fanout/in for integrated OE digital-halftone image compression. Validated enhanced deep-ultraviolet (UV) semiconductor emission for bio-detection and non-line-of-sight ground sensor communications. Incorporated UV emitters into bio-sensor experiments. In FY05, determine utility of polarimetric MMW imaging for aircraft navigation, landing, and obstacle avoidance in limited visibility conditions; mature fast switching real-time algorithms for performing multiple functions in an FCS operational environment; establish improvement in munitions lethality available through dynamic updating; enhance UV emitter efficiency and transition UV emitter technology into unattended ground sensor technology experiments. In FY06, will implement new processor architecture to prove fast switching waveforms in simulated FCS operational scenario; will transition deep-UV emitters with enhanced efficiency into Army bio-sensor R&D programs. In FY07, will integrate communication algorithms into field programmable gate array processor and validate FCS functionality.	2800	2409	2634	2790

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Improve the low echelon commander's situational understanding in complex/urban terrain by maturing infrastructure and validating algorithms, filters and agent technologies to reduce cognitive load by fusing information. In FY04, devised analytical and computing techniques to present information to soldiers and commanders in an easily understood and perceived form. In FY05, transition web-enabled enhanced service-based tools with integrated organizational capability from autonomous asset management and tactical decision aids that reduce both cognitive load and uncertainty. In FY06, will devise a local fusion node which serves as a host for organic air and ground sensor suites that correlates/fuses the local picture from a suite of highly mobile manned and semi-autonomous network and a suite of sensor nodes within an adhoc networking environment. In FY07, will devise for end-user evaluation an integrated warrior software ensemble that provides multi-media based spot/salute report, semi-autonomous platform control, distributed interaction, video source subscription, capture, annotation, and publication to include GPS/compass based blue force/asset tracking; will transition to CERDEC Network Centric Warfare C2 Program (follow on to CERDEC Agile Commander Advanced Technology Demonstration).	2262	2507	2556	2639
Totals	14488	14869	17891	19177

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
SA2	BIOTECHNOLOGY APPLIED RESEARCH	0	2639	3651	5595	5474	5718	5832	5947

A. Mission Description and Budget Item Justification: The objective of this project is to support maturing biotechnology, which is being conducted at the Army's Institute for Collaborative Biotechnology (ICB), an University Affiliated Research Center. 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 exploit breakthroughs in biotechnology basic research transitioning from the ICB to enable revolutionary Future Force capabilities in sensors, electronics and photonics. Areas of research include bio-array sensors, biomimetics, proteomics, genomics, DNA research and development, and control of protein and gene expression. Efforts include designing and performing multi-scale dynamic and predictive modeling to understand the biologically-inspired "sense and respond" systems (integrated system of sensor, information processing and response mechanism) and their components. ARL in collaboration with the ICB industry partners will conduct applied research focused on biological sensors and biological photovoltaics for power generation. 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 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 two areas of emphasis: sensors, electronics and information processing and 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 work in this project was previously funded in PE 0602120A Project H16. In FY05, it has been restructured into a separate project to heighten 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 Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Institute for Collaborative Biotechnology - In FY05, identify mature emerging opportunities in areas such as bio-molecular based detector arrays for new sensors, biological photovoltaic power sources for reduced logistics demand, and biomimetics and biomimetics processing leading to new electro-optic materials, chemical detectors and multifunctional smart materials. In FY06, will investigate the use of the biologically-based and inspired sensors and materials to design and fabricate “sense and respond” system components; will devise and experimentally validate a laboratory scale biological sensor, which will be more selective, compact and provide a significantly reduced logistical burden. In FY07, will design breadboards to integrate the components and incorporate biologically-inspired control and networking capability for “sense and respond” systems; will evaluate the biological sensor in a relevant environment and transition to Edgewood Chemical Biological Center.	0	2639	3651	5595
Totals	0	2639	3651	5595

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		38654	47780	34295	32370	33376	33746	34035	34282
47A	AERON & ACFT WPNS TECH	34033	36636	30238	28203	29129	29457	29712	29929
47B	VEH PROP & STRUCT TECH	3646	3906	4057	4167	4247	4289	4323	4353
47C	ROTORCRAFT COMPONENT TECHNOLOGIES (CA)	975	7238	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The Aviation Applied Research Technology program element (PE) conducts research and expands scientific knowledge in the area of manned and unmanned rotary wing vehicle (RWV) technologies in support of the Future Force and Joint Vision 2020, and, where feasible, exploits opportunities to enhance Current Force capabilities. Based on the Army transformation, this PE investigates technologies applicable to all aviation systems, both manned and unmanned, while providing opportunities for technology insertion into the Current Force systems. Unmanned RWVs bring unprecedented agility, maneuverability, and lethality to the Future Force, while providing improved survivability and reduced logistics costs. Emphasis is on maturing rotary wing platform technologies to support manned and unmanned teaming in 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. These technologies are assessed for their ability to support the long-term sustainability and reduced logistics required of Future Force airframes. Unmanned technologies are directed toward compatibility with the A-160 Hummingbird, the FireScout, the Organic Air Vehicle (OAV), and the Micro Air Vehicle (MAV). This PE also supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry and academia, and adds a major focus to mature unmanned rotorcraft technologies. Project 47C fund Congressional special interest items. Efforts under this PE transition to projects supported by PE 0603003A (Aviation - Advanced Technology). Upgrade activities of Department of Defense (DoD) systems such as the AH-64 Apache, UH-60 Black Hawk, CH-47 Chinook; the U.S. Navy SH-60 Seahawk; and U.S. Marine Corps V-22 Osprey, AH-1 Cobra and CH-53 Super Stallion are included in 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, Redstone Arsenal, AL and the Army Research Laboratory, Adelphi, MD, with facilities located at Fort Eustis, VA; Ames Research Center, Moffett Field, CA; Glenn Research Center, Cleveland, OH; and Langley Research Center, Hampton, VA.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	41629	40127	40057
Current Budget (FY 2006/2007 PB)	47780	34295	32370
Total Adjustments	6151	-5832	-7687
Net of Program/Database Changes			
Congressional Program Reductions	-655		
Congressional Rescissions			
Congressional Increases	7550		
Reprogrammings			
SBIR/STTR Transfer	-744		
Adjustments to Budget Years		-5832	-7687

Change Summary Explanation:
FY06 - Funds realigned ($5832K) to higher priority requirements.
FY07 - Funds realigned ($7687K) to higher priority requirements.

Five FY05 Congressional Adds totaling $7550 were added to this PE.

FY05 Congressional Adds with no R-2As:

($2398) Center for Rotorcraft Innovation, Project 47C: The purpose of this one year Congressional add is to fund a Center for Rotorcraft Innovation. No additional funding is required to complete this project.

($479) Composite Small Main Rotor Blades, Project 47C: The purpose of this one year Congressional add is to fund research in composite small main rotor blades. No additional funding is required to complete this project.

($1007) Mono Tiltrotor/Army Rotorcraft, Project 47C: The purpose of this one year Congressional add is to fund research in mono tiltrotors for

rotorcraft. No additional funding is required to complete this project.

($2397) Silver Fox UAV, Project 47C: The purpose of this one year Congressional add is to fund research on the Silver Fox UAV. No additional funding is required to complete this project.

($959) Xenon Light Source for Non-Lethal Deterrence from Small UAVS, Project 47C: The purpose of this one year Congressional add is to fund research into xenon light source for non-lethal deterrence from small UAVs. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
47A	AERON & ACFT WPNS TECH	34033	36636	30238	28203	29129	29457	29712	29929

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 and Joint Vision 2020 by providing technology to improve capabilities in Force Application and Focused Logistics. Areas of research are on technology applicable to all aviation platforms, with a focus on unmanned aerial vehicle (UAV) systems, manned and unmanned teaming, and opportunities for application on manned systems. These system technologies will provide 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, and adds a major focus to mature UAV designs and other unmanned rotorcraft technologies. The propulsion component technologies investigated in this project will provide improved specific fuel consumption, horsepower to weight ratios, and operation and support (O&S) cost savings for manned and unmanned Future Force systems. These engine component technologies address engine needs for future UAVs, such as the A-160 Hummingbird, with up to a 50% endurance and 30% payload increase over currently available turbine engines. These component technologies will also enable engine demonstrations for manned systems, providing a 33% increase in payload and a 50% reduction in fuel consumption for CH-47 Chinook; and an 80% payload increase and a 20% 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 survivable re-route decision aiding systems. Advanced active controls, aerodynamics, handling qualities, and smart materials (materials that respond to specific stimuli) technologies will 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. This project also supports work accomplished in collaboration with the National Aeronautics and Space Administration (NASA) and work done under the auspices of the NRTC. Technologies researched 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 2004	FY 2005	FY 2006	FY 2007
National Rotorcraft Technology Center (NRTC) - In FY04, conducted component research in the areas of crashworthiness, advanced structures, advanced low-cost composite manufacturing, structural joining technologies, and rotorcraft transmission technologies. NRTC performed applied research efforts in composite durability and damage tolerance, and integrated helicopter design technology. In FY05, conduct research and component testing in technologies that enable rotorcraft performance improvement, limited authority flight control, damage tolerance, and rotorcraft transmission advances. In FY06, will conduct research and component testing in the areas of damage tolerance of materials, rotorcraft integrated analysis and design, advanced transmission technologies, health monitoring technology, rotor load prediction analysis, and gear noise technologies. In FY07, will conduct research and component testing in technologies that enhance manned and unmanned rotorcraft capabilities using active rotor controls, intelligent flight controls, smart composite structures, advanced manufacturing technologies, and advanced subsystem technologies.	6959	7086	7270	7504
Rotor Technology [Includes the Low Cost Active Rotor (LCAR) program and the Lightweight Active Rotor Concept (LARC) program] - In FY04, designed model rotor concepts to demonstrate a 40% vibration reduction and control system weight savings. In FY05, integrate selected candidate lightweight rotor and hub concepts for application of on-blade control and begin integrated concept subsystem tests. In FY06, will start fabrication of Mach-scale model rotor blades and complete model subsystem tests. In FY07, will complete model blades for the LARC rotor and begin evaluation of on-blade primary flight control.	4288	3680	4100	4127

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Survivability [Includes the Manned / Unmanned Rotorcraft Enhanced Survivability program] - In FY04, developed a software design for the real-time Survivability Planner Associate Re-router, tailored to small unit manned / unmanned team operations. Matured a family of intelligent sentinel agents to monitor threat-warning sensors. In FY05, construct a database of threat sensors, multi-spectral signatures, and clutter and jammer effects. Demonstrate real-time threat lethality predictor, with and without jamming, in 3-dimensional terrain environment. In FY06, will integrate intelligent decision aid agent to provide cueing for 'what to do' given threat array. Will integrate intelligent decision aid agent, along with cooperative/collaborative behaviors, to provide cueing for the manned / unmanned team to respond as a team, and not just as individual platforms. In FY07, will demonstrate the Survivability Planner Associate Re-Router (SPAR) system software on manned and unmanned mission management simulators. SPAR will be integrated into an existing manned mission management simulation system and demonstrated using the Advanced Concept Research Tool (ACRT) Longbow Apache simulator at the Army Aviation Center Directorate at Fort Rucker Alabama and an existing unmanned air vehicle mission management simulation system and demonstrated at Lockheed Martin, Owego, New York.	3692	3685	3932	4108

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Structures and Airframe [Includes the Survivable, Affordable, Repairable Airframe Program (SARAP)] - In FY04, designed and fabricated smart re-configurable airframe and rotors structures for bench tests. Designed and evaluated multifunctional structures for reduced signature, weight, and enhanced survivability. Investigated technologies for affordable, low weight, reparable structures that enhance ballistic and crash survivability. In FY05, validate and disseminate improved loads determination tools that are 25% more accurate. Conduct bench tests on smart re-configurable airframe and rotors structures. Standardize (Joint Service) test methods for durability and damage tolerance certification / qualification of composite structures. Demonstrate field and depot level advanced composite airframe inspection and repairs. Evaluate conceptual re-configurable panels, blades and self-healing structures. In FY06, will generate and evaluate structures that incorporate ballistic protection and survivability features. Will evaluate and mature concepts that are self-sensing and self-healing (smart parts). In FY07, will validate Mode III and Mixed-Mode (II & III) fracture mechanics failure modes and test methods to support Durability and Damage Tolerance (D&DT) certification methodology for composite structures. Will generate technologies to reduce structural integrity uncertainty for lower load factors on airframes/rotors.	2624	2310	2323	2469
Propulsion [Includes the Small Heavy Fuel Engine (SHFE) program]- In FY04, conducted rig test of advanced power turbine providing increased cycle efficiency and reduced engine weight. Completed fabrication of 700 horsepower class compressor for improved full- and part-power performance. Completed design of advanced foil bearing. In FY05, conduct rig test of 700 horsepower compressor for improved performance. Complete fabrication and component evaluations of advanced foil bearing. Complete fabrication of 700 horsepower class ceramic turbine and rig hardware. Start design of ceramic matrix composite power turbine blades. In FY06, will complete design of advanced ceramic matrix composite power turbine blades. Will demonstrate advanced foil bearing via rig test. Will conduct rig test of 700 horsepower class ceramic turbine. In FY07, will complete fabrication of advanced ceramic matrix composite power turbine blades. Will complete design of advanced technology combustor.	1379	1425	1477	1530

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Networked Operations and System Integration [Includes the Precision Automated Landing Adaptive Control Experiment (PALACE), flight controls, human factors, and weapons integration concepts]. PALACE - In FY04, evaluated control law and sensor optimization in simulation for precision autonomous landing of UAVs. Modified a (Yamaha) RMAX rotorcraft surrogate UAV for precision autonomous landing experiments. Awarded three contracts to develop seven different operationally relevant behaviors for UAVs, e.g., cooperative reconnaissance and security, avenge kill/team protection, etc. In FY05, flight-demonstrate precision autonomous landing of VTOL UAV to unprepared site in GPS denied environment. Complete piloted simulation investigating advanced operator interface and control methods for airborne control of tactical UAVs. Research autonomous control laws and operator interface for UAV cargo rotorcraft/sling load handling qualities. Generate software to implement the seven UAV behaviors and integrate the software in a government simulation facility for evaluation. Award a contract option for a flight demonstration. In FY06, will demonstrate rotorcraft UAV autonomous flight, navigation, and landing in an obstacle environment with passive/active imaging sensors. Will define mission-specific optimal levels of control for UAV operations. Will conduct an experiment to define crew sensor display configurations for control of multiple UAVs. Will validate closed-loop individual blade control (IBC) algorithms using data from full-scale wind tunnel test. In FY07, will conduct simulation demonstration of synthetic vision system for UAV operations. Will conduct initial human factors experiments in adaptive levels of control for UAV operations. Will conduct flight demonstration of multi-vehicle collaboration in low altitude surveillance with heterogeneous platforms/sensors. Will complete RASCAL JUH-60A flight test of tactile cueing and advanced control laws suitable for advanced utility	10166	13315	5503	2734
Networked Operations and System Integration [Includes Part 1 of the Unmanned Autonomous Collaborative Operations (UACO) ATO program. Part 2 of UACO is under 63003/313] - In FY04, conducted requirements analysis and concept definition studies for multi-UAV control to handle multiple integrated mission operations. In FY05, conduct preliminary design of UAV "swarm" control for vehicle, mission equipment, and flight management architectures. Evaluate system performance, effectiveness, and risk. In FY06, will conduct simulation demonstrations at the contractor and government facilities, and flight test autonomous collaborative UAV behaviors from one of the three contractors using multiple small UAVs. Will initiate integration of airborne sniper capability for Vigilante test-bed UAV. In FY07, will conduct flight test demonstrations of airborne sniper capability using Vigilante UAV and airborne control from a UH-1 or Blackhawk.	4925	5135	5633	5731

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Totals	34033	36636	30238	28203

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
47B	VEH PROP & STRUCT TECH	3646	3906	4057	4167	4247	4289	4323	4353

A. Mission Description and Budget Item Justification: The Vehicle Propulsion and Structure Technology project investigates engine, drivetrain and airframe technologies for Army Department of Defense (DoD) rotorcraft sin 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. The 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 inability to design for acceptable reliability and durability with current tools, 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. The propulsion research is focused on fluid mechanics, high temperature materials, and mechanical behavior for significantly improved small airflow turbine engines, transmissions, and gears, bearings, and shaft components for advanced drivetrains at significantly reduced weight and cost. This propulsion research supports the goals of the DoD Versatile Advanced Affordable Turbine Engine (VAATE) program. The 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 2004	FY 2005	FY 2006	FY 2007
Rotor & Structure Technology [Includes the Survivable, Affordable, Repairable Airframe Program (SARAP), the Low Cost Active Rotor program, and the Lightweight Active Rotor Concept program] - In FY04, investigated reliability-based design methods, durability and damage tolerance analysis methods, crashworthiness concepts, and Non-Destructive Evaluation (NDE) methods on selected airframe and rotor hub components; investigated advanced design concepts for on-blade active control rotor systems; designed a composite active tail system wind-tunnel testbed based on the AH-64D; and completed study of soft-inplane rotor systems for application to a heavy lift tiltrotor. In FY05, validate reliability-based design methods, durability and damage tolerance analysis methods, lightweight crashworthy concepts, and advanced NDE methods in support of SARAP; complete wind-tunnel demonstration of new lightweight and stable heavy lift tiltrotor concept. In FY06, will conduct hover and wind tunnel experiments on advanced active twist rotor system using AH-64D Apache as baseline; evaluate reliability, durability and damage tolerance for tailored and multi-functional composite structures. In FY07, will conduct wind-tunnel test in cooperation with Bell Helicopter to evaluate new heavy lift tiltrotor hub design; develop multi-functional structural concepts and design tools to reduce ballistic vulnerability for airframes applicable to heavy lift rotorcraft.	1846	1946	1604	980

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Propulsion & Drive Train Technology [Includes the Rotorcraft Drive System for the 21st Century (RDS21) program and the Small Heavy Fuel Engine (SHFE) program] – RDS21 - In FY04, analyzed performance of a compact high performance two-stage engine compressor and cooled monolithic ceramic and ceramic matrix composite turbine nozzles. Researched a full 3-dimensional distributed propulsion simulation. In FY05, conduct experiments and computer simulations of active stall control technologies to extend stable engine operation. Investigate autonomous propulsion system technology for future UAV propulsion control and operation. In FY06, will demonstrate and validate active stall control technology and transition to government and industry. In FY07, will 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. SHFE – In FY04, determined the optimal pinion tooth design for face gear endurance tests in support of the RDS21 program. In FY05, perform laboratory endurance tests of face gears to evaluate strength and durability. In FY06, will evaluate environmental and thermal barrier coatings for silicon nitride turbine nozzles. Will complete 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. Will perform rotor-dynamic tests of an oil-free foil air bearing technology that will reduce engine maintenance costs by 50% and weight by 15%. In FY07, will evaluate heavy-fuel concepts for potential fuel cell applications. Will complete performance and endurance tests of innovative non-contacting air-to-air seal technology for military helicopter and UAV class engines. Will demonstrate and test a low conductivity thermal barrier coating system.	1800	1960	2453	3187
Totals	3646	3906	4057	4167

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		16704	19703	19129	19075	16281	16370	16512	16633
442	TACTICAL EW TECHNOLOGY	10431	11104	11545	11753	9346	9398	9479	9549
475	ELECTRONIC WARFARE COMPONENT TECHNOLOGIES (CA)	0	2109	0	0	0	0	0	0
906	TAC EW TECHNIQUES	6273	6490	7584	7322	6935	6972	7033	7084

A. Mission Description and Budget Item Justification: This Program Element (PE) researches and investigates electronic warfare (EW) technologies to improve the Army's battlespace survivability, acquisition of enemy targets, situational awareness (SA) for use in the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. 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. Project 906 funds efforts related to research and application of key 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. The intent of the PE is to research and evaluate technologies that will deny, disrupt, or degrade the enemy's use of the electromagnetic spectrum for offensive or defensive operations. 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 improvised explosive devices. The PE will provide deployed Future Force elements with information dominance and increased force protection. 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. Work in this PE covers the spectrum in the radio frequency (RF), infrared (IR), electro-optical (EO), ultra-violet (UV), magnetic and acoustic ranges. In addition, this PE 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 SA, targeting, and combat identification. This PE will provide information fusion research that will address sensor data reduction through use of automated processing, as well as higher level reasoning techniques that support automated combat assessment. This PE includes Electronic Support, Sense Through the Wall, Advanced Radar Deception and Countermeasures, Sensor Countermeasures, Fusion processing, Networked Sensors, and Information Operations efforts. 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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	18034	20806	20663
Current Budget (FY 2006/2007 PB)	19703	19129	19075
Total Adjustments	1669	-1677	-1588
Net of Program/Database Changes			
Congressional Program Reductions	-293		
Congressional Rescissions			
Congressional Increases	2200		
Reprogrammings			
SBIR/STTR Transfer	-238		
Adjustments to Budget Years		-1677	-1588

Change Summary Explanation:

Two FY05 Congressional Adds totaling $2200 were added to this PE.

FY05 Congressional Adds with no R-2A:
($1151) Biometric Signatures Research, Project 475: The purpose of this one year Congressional add is to research the combination of biometric & waveform emissions for identification, tagging, detecting & tracking. No additional funding is required to complete this project.

($959) Subterranean Target ID Program, Project 475: The purpose of this one year Congressional add is to research the detection/classification of underground structures using seismic sensors and processing. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
442	TACTICAL EW TECHNOLOGY	10431	11104	11545	11753	9346	9398	9479	9549

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 will provide detection avoidance through signature management and hit avoidance using warning receivers and electronic countermeasures. This project will apply recent advances in radio frequency (RF), infrared (IR) and electro-optical (EO) sensor and jamming sources to detect, locate, deceive and jam Improvised Explosive Devices (IEDs), 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 IEDs will be researched with the goal of embedding the maximum capability in projected Future Combat Systems (FCS), and Future Force systems to minimize 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. A substantial amount of work will be accomplished under The Technical Cooperation Program (TTCP) Electronic Warfare Systems (EWS) Panel and cost sharing under project arrangements with the United Kingdom and Australia. Finally, this project will look at those Electronic Support (ES) technologies used against non-communications signals for targeting and tactical Situation Awareness (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 2004	FY 2005	FY 2006	FY 2007
- Electronic Support for the Future Force: This effort researches technologies to collect, identify, locate, and track hard to detect communications emitters on the battlefield that are otherwise unavailable through space, airborne, or other assets. This will provide full spectrum electronic collection and mapping for the Future Force. In FY04, integrated and tested multi-path mitigation software; transitioned modulation recognition software to test bed and evaluated in field test; pursued advanced simulation capabilities to define the utility of Unmanned Ground Vehicle (UGV) and UAV sensors. In FY05, develop and provide advanced simulation capability to refine the operational utility of UGV and UAV signals intelligence sensors in the Mounted Maneuver Battlespace Lab at Fort Knox and continue sensor, antenna, and receiver design efforts. In FY06, will evaluate UAV and UGS electronic support measures in a warfighter operational environment that demonstrates real time collection, ID and location with sensor data fusion.	2700	3300	2000	0
- Sensor Countermeasures for the Future Force: In FY04, developed and demonstrated electronic countermeasures capable of neutralizing remotely detonated booby traps; transitioned this capability to PM Electronic Countermeasures for immediate fielding to US troops. In FY05, collaborate with other U.S. and foreign government agencies on threat and countermeasure techniques; conduct deception and jamming technique research; investigate modeling and simulation hardware and software; expand the investigation and conduct field-testing of countermeasures against RF and IR links for detonation of booby traps; assess potential for embedding the countermeasure capability in near term systems. In FY06, in response to the evolving threat environment, continue collaboration with other U.S. and foreign government agencies on threat and countermeasure techniques; conduct deception and jamming technique research; conduct simulation against potential threats; investigate and conduct field-testing of countermeasures against RF and IR links (and others depending on threat) for detonation of booby traps; assess potential for embedding the countermeasure capability in near term systems. In FY07, will conduct field testing to demonstrate countermeasure effectiveness against enemy sensors.	2700	4105	4860	1457

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Suite of Sense Through the Wall Systems (STTW) for the Future Force: This effort will provide 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 FY04, assessed the feasibility of various technologies (i.e., RADAR, millimeter wave, acoustic, x-ray) for STTW applications; designed advanced processing techniques and improved algorithms leading to the next generation STTW system with increased standoff, a user-friendly graphical user interface (GUI), accurate target geo-location, and detection of multiple targets through walls. In FY05, continue maturation of the STTW system and the investigation of technologies for concealed weapons detection/concealed explosives detection (CWD/CED); develop and refine techniques for detection of stationary personnel through light construction materials; integrate prototypes with emerging Unit of Action and Future Force Warrior (FFW) network communications architectures to demonstrate transmission of STTW data on a real time basis; evaluate data transmission, dissemination, and software tools; provide STTW performance model for incorporation into Battle Lab and FFW operational modeling & simulation. In FY06, will conduct lab and user testing of STTW prototypes; will utilize experiments to develop tactics, techniques, and procedures (TTPs) and characterize urban and complex terrain phenomenology. In FY07, will begin development of integrated personnel detection/CWD/CED systems with greater standoff capability and increase probability of detection; will conduct lab testing of individual STTW sensors against multiple wall types, and formulate techniques for detection of stationary personnel through multiple wall types; will demonstrate hand held STTW prototype with the FFW ATD.	1631	2699	3685	3911

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Fusion Based Knowledge for the Future Force: In FY04, identified and analyzed the full set of cognitive tasks the Future Combat System's Unit of Action analysts must perform to answer commanders' priority intelligence requirements (a set of intelligence fusion tasks); completed a requirements analysis and data models for utilizing several intelligence sources to support data fusion processing; integrated two more data sources (All Source Analysis System-Light, and a meteorological system) into the baseline system needed to handle multiple intelligence and data sources; developed a software prototype multi-dimensional data structure to allow an analyst to direct the search for patterns of interest in the data. In FY05, develop scenarios, construct data sets, and identify metrics, to conduct a pilot experiment for assessing fusion tools needed to answer commander's priority intelligence requirements. In FY06, will use software technologies to represent knowledge needed to logically link multiple, diverse sources of data to answer the commander's priority intelligence requirements. In FY07 will complete process of acquiring knowledge from analysts and implementing in fusion reasoning software, and finalize refinements to software for representing knowledge and reasoning for answering priority intelligence requirements.	700	1000	1000	1000
- Multispectral Laser & Missile Warning and EO/IR Imaging Missile CM: In FY07, will investigate technologies applicable to next generation laser and missile warning systems and develop those technologies which have the greatest potential to increase system performance while reducing the size, weight, power consumption and cost of currently fielded systems; will develop devices and techniques to effectively counter imaging missiles that are proliferating and pose a serious threat to Army platforms; will evaluate techniques to counter laser beam riding missiles.	0	0	0	5385
- Advanced Radar Deception and Countermeasures: In FY04, completed a high speed, wide band, electronic countermeasure testbed; utilized the testbed for evaluation of countermeasure techniques against Low Probability of Intercept and battlefield surveillance radars in the laboratory and in a controlled field environment. These techniques effectively jammed top attack munitions, artillery and anti-aircraft artillery fuzes causing 90% prefunction of all rounds significantly beyond the lethal distance of the round.	2700	0	0	0
Totals	10431	11104	11545	11753

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
906	TAC EW TECHNIQUES	6273	6490	7584	7322	6935	6972	7033	7084

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 will contribute to the commanders ability to see the enemy, both in whole and as part of a complex, adaptive organization, allowing a "See First, Understand First, Act First" standard of operations. This project matures radio frequency (RF) collection and mapping technologies into integrated multifunction devices, 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 will enable 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 provide tools to the Unit of Action (UA) enabling 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 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 2004	FY 2005	FY 2006	FY 2007
- Electronic Support for the Future Force (ESFF) & Networked Sensors for the Future Force (NSfFF): This effort researches and investigates EW sensors and electronics signal processing technologies. In FY04, designed compact RF receiver architectures that will enable the deployment of remote, unmanned ESM(Electronic Support Measures)/Signals Intelligence (SIGINT) sensors and enhanced the effectiveness of the Future Force Warrior. In FY05, research ESM/SIGINT system capabilities that will operate in unmanned networked environments to detect tactical RF transmissions that can support the movements of the Future Combat Systems warfighters; investigate the ability to integrate the unmanned ESM/SIGINT sensor systems with Networked Sensors for the Future Force ATD communications equipment. In FY06, will test UAV and UGS ESM in a warfighter operational environment that demonstrates real time collection, ID and location with sensor data fusion.	4455	4123	5184	0
- Information Operations: In FY04, developed urban characterization hardware, and completed the first representative signals environment survey; began signal and traffic analysis work; demonstrated unintentional radiation detection capability; successfully demonstrated the ability to detect and distinguish target traffic in a lab environment; identified receiver technology to support future geolocation efforts and for potential use in force protection. In FY05, identify and test network analysis and data recognition techniques for RF emission, geolocation and virtual address locations in a lab environment. In FY06, will mature signal analysis work and cross cueing/correlation capability for RF emission geolocation and virtual address locations and demonstrate the capability to perform precision detection and location of emitters in a lab environment.	1818	2367	1400	0
- Fusion Based Knowledge for the Future Force: In FY06, will conduct experiments and demonstrations to show software architectural capabilities to rapidly develop and maintain multiple interpretations and associated confidence levels to answer commander's priority intelligence requirements; will finalize warfighter directed software for finding interesting patterns (discovering knowledge) in multi-dimensional data supporting intelligence fusion, and identify requirements and construct initial information agents to support intelligence retrieval of information from diverse data sources. In FY07, will finalize development activities of software architecture capabilities and assess its utility to more rapidly develop highly plausible interpretations as answers to commanders' priority intelligence requirements; will finalize development of information agents required for efficient and effective information retrieval in support of intelligence fusion processing.	0	0	1000	1000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
– Future Comm Signal Detection, Location & Classification & Modern C2 Attack: This effort will focus on the detection of communications systems that utilize advanced technologies to enable operations against threat systems in extremely dense signal environments. In FY07, will research the threat use of modern high capacity modulation methods, frequency reutilization capabilities, low probability of intercept techniques, and the technologies that are driving these systems; will develop methods of attacking these capabilities to achieve spectrum dominance.	0	0	0	6322
Totals	6273	6490	7584	7322

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602303A - MISSILE TECHNOLOGY

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		89332	82781	62524	65801	55487	44711	40017	38322
214	MISSILE TECHNOLOGY	37320	34104	44824	53869	55487	44711	40017	38322
223	AERO-PROPULSION TECHNOLOGY	24446	28280	0	0	0	0	0	0
340	SWORD	2922	0	0	0	0	0	0	0
G02	ARMY HYPERSONICS APPLIED RESEARCH	7891	8749	17700	11932	0	0	0	0
G04	AIR DEFENSE TECHNOLOGIES (CA)	4481	1343	0	0	0	0	0	0
G05	MISSILE TECHNOLOGY INITIATIVES (CA)	3312	3595	0	0	0	0	0	0
G06	UNMANNED SYSTEMS TECHNOLOGIES (CA)	8960	6710	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This applied research Program Element (PE) researches and investigates advanced technologies for missiles, rockets, and launch systems for use in the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The overall objectives of the PE are to increase the survivability of launch systems; provide greater lethality and effectiveness under adverse battlefield conditions; increase kill probabilities against diverse targets; and provide powerful new simulation and virtual prototyping analysis tools. A major cross-cutting theme is developing missile technology that is smaller, lighter weight and more affordable. Major technology areas include missile guidance systems, air defense systems, multi-spectral seekers, high fidelity simulations, missile aerodynamics and structures, missile propulsion including research to help solve the insensitive munitions requirements for missiles, hypersonic missile efforts, and the maturation of a common high-gravitational force (high-g), low cost, Micro Electro-Mechanical Systems (MEMS) Inertial Measurement Unit (IMU). The goal of the high-g MEMS IMU program is to design and develop reliable precision guidance for missiles and guns at a significantly lower cost than current systems. A second objective of the high-g, low cost MEMS program is a deeply-integrated guidance and navigation unit (DIGNU). The DIGNU effort will develop and demostrate an IMU or Inertial Sensor Assembly (ISA) with the same 1.0 deg/hr, and greater than 20,000 g's survivability requirements of the initial program with an additional "deeply-integrated" or "deeply-coupled" GPS military receiver incorporating a single microprocessor architecture and integrated hardware within a Selective Availability and Anti-Spoofing Module (SAASM) and software anti-jam (AJ) capability. The deliverable DIGNUs will be less than 4 cubic inches and will use a single microprocessor to absorb the mission computer processing functions found in 90% of all DoD guided munitions and missiles.The high-g MEMS IMU program is a joint project between the Armament Research, Development and Engineering Center, and Aviation and Missile Research, Development and Engineering Center. 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 deliver small, light weight force protection technology that is 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 is an effort to develop the interceptor and fire control technology necessary to provide the Future Combat Systems Unit of Action (UA) an air defense capability, particularly against Rockets, Artillery, and Mortars (RAM). The Army Hypersonics Applied Research program explores and matures the critical technologies required for expendable hypersonic missiles and will advance the national goals in hypersonic weapon maturation and access to space. This 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), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	51993	59900	46443
Current Budget (FY 2006/2007 PB)	82781	62524	65801
Total Adjustments	30788	2624	19358
Net of Program/Database Changes			
Congressional Program Reductions	-8923		
Congressional Rescissions			
Congressional Increases	41650		
Reprogrammings			
SBIR/STTR Transfer	-1939		
Adjustments to Budget Years		2624	19358

Change Summary Explanation:
FY07 - Increased funding ($19358) provides active protection against Unmanned Vehicles, Missiles and RAM.

Eight FY05 Congressional Adds totaling $41650 were added to this PE.

FY05 Congressional Adds with no R-2A:
($1438) Army Flight Test, Project 223: The purpose of this one year Congressional add is to fund research on Army flight tests. No additional funding is required to complete this project.

($959) Agile MEMS/Nano-Technology for Wireless Security and Defense Applications, Project G05: This one year Congressional add is to fund research on nano-technology for wireless security and defense. No additional funding is required to complete this project.

($14386) Hypersonic Army Missile Technology, Project 223: The purpose of this one year Congressional add is to advance distributed processing for hypersonic computational fluid dynamics. No additional funding is required to complete this project.

($2397) LENS X Hypervelocity Ground Testing, Project 223: The purpose of this one year Congressional add is to fund research on LENS X hypervelocity ground testing. No additional funding is required to complete this project.

($1343) Maneuver Air Defense System (MADS), Project G04: The purpose of this one year Congressional add is to perform force-level trade studies and mission requirements analysis, establish a best technical approach and begin demonstrating critical technologies in support of the Extended Area Air Defense System (EAADS). No additional funding is required to complete this project.

($10069) MARIAH II Hypersonic Wind Tunnel Development Program, Project 223: The purpose of this one year Congressional add is to develop component technologies required for pilot scale test facility to produce actual flight conditions for timeframes orders of magnitude greater than currently available. No additional funding is required to complete this project.

($2637) Microelectromechanical Systems (MEMS) and Nanotechnology, Project G05: This one year Congressional add is to fund research on microelectromechanical systems and nanotechnology. No additional funding is required to complete this project.

($6712) Unmanned Systems Initiative (USI) at the Aviation and Missile Research Development and Engineering Center (AMRDEC), Project G06: The purpose of this one year Congressional add is to focus on immediate efforts to support the development of unmanned systems through interoperability and the delivery of lethal payloads to better position the military for situations in homeland defense and urban scenarios. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
214 MISSILE TECHNOLOGY	37320	34104	44824	53869	55487	44711	40017	38322

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 the Future Combat Systems (FCS) and Future 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 in the efforts in this project is developing Smaller, Lighter weight, and Cheaper (SLC) missile technology to reduce the cost and logistics burden of precision munitions. Research objectives are to enhance the survivability of launch systems, provide greater effectiveness under adverse battlefield conditions, increase kill probabilities against diverse targets, and provide powerful new simulation and virtual prototyping analysis tools. The major effort in this project is the high-gravitational force (high-g), low cost Micro Electro-Mechanical Systems (MEMS) Inertial Measurement Unit (IMU) program. The Army is the Service lead in the investigation of low cost MEMS IMUs capable of supporting precision guidance requirements of DoD's missile and gun launched precision munitions programs. 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.) The High-g MEMS IMU will also be transitioned to Excalibur, Extended Range Gun Munition (ERGM), and 120-mm Line-of-Sight / Beyond Line-of-Sight (LOS / BLOS) Advanced Technology Demonstration (ATD). This is a joint program with the Armament Research, Development and Engineering at Picatinny Arsenal. A second objective of the high-g, low cost MEMS program is to develop a deeply-integrated guidance and navigation unit (DIGNU). The DIGNU effort will develop and demonstrate an IMU or Inertial Sensor Assembly (ISA) with the same 1.0 deg/hr, and greater than 20,000 gs survivability requirements of the initial program with an additional "deeply-integrated" or "deeply-coupled" GPS military receiver incorporating a single microprocessor architecture and integrated hardware within a Selective Availability and Anti-Spoofing Module (SAASM) and software anti-jam (AJ) capability. Another effort, 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 apply structronics technologies to the electronics substrate such that the substrate becomes the chassis, wiring harness, and printed wiring board for the electronics. Each of these elements will be incorporated into a series of Integrated Guidance Units (IGU's) which will consist of a guidance computer and an inertial measurement unit. Also included in this project is an effort to develop the technology necessary to provide the Unit of Action (UA) an air defense capability, particularly against rockets, artillery, and mortars (RAM). 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- High-G Microelectromechanical Systems (MEMS) Inertial Measurement Unit (IMU) - High-G MEMS IMU - In FY04, matured and live-fire tested IMUs to meet the parameters: Gyro Bias < than 20 degrees/hour, Vol. less than 4 cubic inches, Acceleration Bias less than 4 milli-g's, Gun-Hardened to 20,000g; performed electronic miniaturization necessary to fit on the two-inch diameter electronics board; redesigned the vibration isolation system for the modified mass. In FY05, perform test and evaluation on the Phase 2 IMUs. The Phase 2 IMUs will be tested to meet the following parameters: gyro bias less than 20 deg/hr, volume less than 4 cubic inches, accel. bias less than 4 millig, and gun-hardened to 20,000 gs. Laboratory characterization tests will be performed on software selectable spin rates: a 4 Hz roll rate version required for missiles and a 20 Hz roll-rate version required for munitions; perform additional electronics miniaturization to reduce the volume of the IMU to four cubic inches; improve digital IMU electronics design; and perform missile flight tests with the Phase 2 IMUs. In FY06, will use advanced die packaging techniques to support miniaturization of IMUs to less than 4 cubic inches volume; incorporate out-of-plane gyros and in-plane accelerometers or other novel sensor packaging strategies to get to smallest possible IMU volume; develop die attach methods, develop a new design process for Application-Specific integrated Circuits (ASICs), design a new internal isolator and integrate the gyro, accelerometer, and microprocessor functions in a single IMU to improve signal isolation. Perform test and evaluation on the early Phase 3 IMUs. In addition, the vibration isolation system will be redesigned for the modified mass and diameter. The 20,000 g launch challenge will require board stiffness redesign with emphasis on high yield and low cost for the IMU. In FY07, perform test and evaluation on the final Phase 3 IMU deliverables.	7603	10000	14600	5180

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- High-G Microelectromechanical Systems (MEMS) Deeply Integrated Guidance and Navigation Unit (DIGNU). In FY05, perform test and evaluation of the DIGNU1s developed under FY04 Congressional add. The DIGNU1s will be tested to meet the following parameters: gyro bias less than 75 deg/hr, volume less than 28 cubic inches, accel. Bias less than 9 millig and gun-hardened to 10,000 gs. Field tests will be performed on the DIGNU1s to test GPS/INS performance. In FY06, will mature the deep integration algorithms. Performance issues identified during live field tests will be addressed in redesign to improve performance. Missile flight tests will be supported with both Phase 2 DIGNUs and will also perform laboratory test and evaluation of the DIGNU2s. The DIGNU2s will be tested to meet the following parameters: gyro bias less than 20 deg/hr, volume less than 12 cubic inches, accel. bias less than 4 millig and gun-hardened to 15,500 gs. Will perform field tests on the DIGNU2 to determine GPS/INS/anti-jam capability; mature and further miniaturize internal anti-jam capability; test application platform interface software and finalize commonality requirements between the units from the two contractors; test G-operational requirements and expanded temperature range requirements for the DIGNU2 products. In FY07, will perform field tests and laboratory characterization on DIGNU3s including anti-jam capability; further miniaturize the anti-jam module, modify and retest any issues identified during testing of DIGNU2 and perform test and evaluation on the DIGNU3s. The DIGNU3s will be tested to meet the following parameters: gyro bias less than 1 deg/hr, volume less than 5 cubic inches, accel. bias less than 1 millig, greater than 90 db J/S and gun-hardened to 20,000 gs.	0	4000	5400	4820
- High-g MEMS/IMU Technology Development Acceleration – In FY04, this one-year Congressional add developed and substantiated an IMU "deeply integrated" with a Selective Availability Anti-Spoofing Module (SAASM) Global Positioning Systems (GPS) military receiver incorporating a single microprocessor architecture and incorporating integrated hardware and software anti-jam capability. Additionally, this add made manufacturing and process improvements to reduce cost, and reduce process, manufacturing, and testing variability to facilitate the production of the final MEMS IMU and deeply integrated GPS navigational unit design. No additional funding is required.	8189	0	0	0
- Low Cost Guidance Navigational Unit - This one-year Congressional add enhanced an existing guidance navigations unit design that will lower cost and power. In addition, anti-jam technology was prototyped, tested, and evaluated. No additional funding is required.	940	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Smaller, Lighter, Cheaper (SLC) Tactical Missiles. - SLC focuses technology to reduce the cost and logistics burden of precision munitions. Through innovative application of technology in concert with more efficient production and integration processes, this program's goal is to reduce the cost per kill of precision guided missiles. In FY05, perform assessment of current and future precision guided missile capabilities and gaps. Match innovative component technology and/or new weapon concepts to both reduce the cost per kill for precision weapons and, where needed, to fill gaps with a new capability. Reach consensus within the Army on key areas for focus, gaps to be filled, and the appropriate balance between cost and performance. Initiate requests for information from industry on identified topics. In FY06, initiate efforts with industry to design identified components for reduced cost per kill (e.g. seekers, warheads, guidance electronics). Construct simulation modules of each subsystem to facilitate design tradeoffs and verification. Where feasible, demonstrate the tradeoffs between cost and performance in force-on-force simulations. Address manufacturability and produceability issues from the start of design. In FY07, begin testing of subsystem componentry with laboratory testing, captive-carry, and/or warhead arena testing; prepare plans for full subsystem testing; continue to refine subsystem simulation modules which can be incorporated into weapon system simulations for evaluation of new subsystems on various system performances. Update cost models to enable production cost prediction of new designs.	0	500	1500	5900

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Missile Guidance Systems and Seeker Technology - In FY04, performed laboratory tests of infrared counter-countermeasures (CCM) guidance algorithms, devised hardening techniques and algorithms for infrared (IR) seekers to defeat laser CCM; and enhanced MEMS angular rate sensors with vibration feedback for signal. Validated electrical design for guidance computer and mechanical/electrical interface requirements for prototype Integrated Guidance Units (IGU's). Conducted feasibility analyses electronics substrate technologies capable of reducing electronics size, weight, and cost and developed technology roadmap. In FY05, mature controlled arrays of MEMS sensors to provide full dynamic performance ranges, design geometry transformations for rapid retraining of automatic target recognition (ATR) systems, evaluate IR CCM guidance algorithms in a seeker; mature concepts for advanced uncooled IR seeker and sensor hardware; design, mature, and test advanced optics, signal processing, guidance and control techniques and conduct captive carry tests of prototype uncooled seeker. Build a prototype IGU based on proven design. In FY06, will integrate uncooled IR prototype hardware with advanced guidance and control signal processing techniques; will demonstrate RF and optical phase shifters for phased arrays for tactical seekers via laboratory tests. Will perform lab test of damaging laser IRCM threats optical components. Will spiral in stackable substrates and chip scale packaging into the Block 1 IGU. Build and test and compare to baseline IGU design. In FY07, will evaluate uncooled IR concepts and demonstrate prototype configurations, fabricate and test a passive phased sub-array from optical phase shifters and initiate transition of the technology. Will integrate damaging IRCM algorithms and optics in a seeker and perform hardware-in-the-loop testing. Will spiral in die stacking and die thinning into the Block 2 IGU and build, test and compare to baseline IGU design.	7670	9640	10859	13988

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- 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 FY04, completed the design for a method of rapid IR passive signature prediction using the Multi-Service Electro-optics Signature (MuSES) code and investigated techniques for modeling target signatures as perceived by Laser Detection and Ranging (LADAR) sensors and S-band radar; characterized supersonic/hypersonic aerodynamic missile controls and power-on base drag; investigated NLOS-LS missile geometry and thrust level prediction methodologies. In FY05, will develop and extend the techniques for modeling target signatures and backgrounds as perceived by LADAR sensors; will complete initial software design for real-time improved control of simulation facilities. Will characterize aerodynamics for non-cylindrical and non-typical missile configurations. Implement new power-on base drag methods in simulation. In FY06, will apply LADAR target signature modeling to specific targets and backgrounds; will complete the design of real-time simulation control software. Will extend aerodynamic predictive techniques by validation with detailed measurements. In FY07, will integrate LADAR, passive IR and visible scene generation techniques on personal computer (PC) hardware; will integrate real-time simulation facility software control to all types of facilities. Will refine aerodynamic prediction methods to maximize benefits from advances in computational power and capabilities. Investigate novel aerodynamic control methods unique to smaller, lighter, more affordable missiles.	2030	2710	3280	4191

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Smart, Stealthy, Smokeless Missile Propulsion and Smart Structures and Enhanced Lethality – In FY04, completed deep throttling booster design and fabricated hardware, conducted functional demonstration of critical components, and began Computational Fluid Dynamics (CFD) model validation. Completed MOUT wall perforation testing and analysis. Demonstrated increased warhead effectiveness in MOUT room structure through use of Metal Augmented Charge (MAC) fill sleeve. Demonstrated controlled fragmentation of the Multi-Purpose Warhead design without degradation to the shaped charge performance. In FY05, complete design, fabricate and demonstrate self-regulating spring assembly or squib actuation in variable area nozzle (VAN) brassboard hardware. Perform tandem warhead integration and performance testing of advanced compact shaped charge with fragmenting body design. Testing warhead Insensitive Munitions design features and additional thermobaric fills. Investigate various fragmentation methods, materials and penetration studies against various classes of targets. Develop Lethality Design Tool Set to characterize system effectiveness against various targets. In FY06, will design, fabricate and static test integrated spring assembly actuator and VAN concept in a system configuration. Will mature integration of compact shaped charge warhead with enhanced fragmentation design features into a tandem system concept. Demonstrate the addition of thermobaric explosive to enhanced lethality of warhead sub-system. In FY07, will complete testing of VAN and update design concepts. Complete subsystem integration test in order to demonstrate projected increase in performance and decrease in sensitivity of the motor. Will demonstrate a combined effects compact warhead integrated into a tandem warhead missile system against a target set. Investigate the integration of scalable warhead concepts in missile systems.	3270	4154	5085	6490
- Insensitive Munitions Research - In FY04 initiated a focused insensitive munitions (IM) research effort on meeting the IM requirements for missiles and conducted formulation studies with less sensitive propulsion chemical formulations. In FY05 complete formulation research and identify controlled motor case venting techniques and candidate materials for lightweight barriers. In FY06 will conduct ballistic/aging studies on new less shock sensitive minimum smoke formulations and new formulations; and will evaluate lightweight barrier concepts, demonstrate motor case venting concept. In FY07, will evaluate existing and new energetic ingredients for insensitive munition beneficial characteristics; conduct formulations studies for emerging oxidizers, thermal additives, and nitramine replacements; and apply emerging materials/concepts to canister/case design.	994	1100	1100	1300

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Defense Against Rockets, Artillery and Mortars (RAM) - Inteceptor Development. - In FY04, performed interceptor concept exploration and identified critical supporting component technologies. In FY05, mature interceptor concepts, establish interceptor best technical approach(es), and develop a draft interceptor specification. In FY06, will begin the design and development critical supporting component interceptor technologies, including lethal mechanism, propulsion and low cost guidance and control mechanisms. In FY07, will complete the component fabrication and bench and field-testing of critical lethality, propulsion, and guidance and control technologies.	1000	1000	1800	6500
- Defense Against Rockets, Artillery and Mortars (RAM) - Fire Control and Systems Architecture - Investigates fire control components and the integration of the fire control and interceptor technologies into a robust system architecture. In FY04, performed fire control and systems architecture concept exploration and identified critical supporting component technologies. In FY05, mature fire control sensor, acquisition and tracking concepts; establish the best technical approach(es); develop a draft fire control specification; develop draft system architectures integrating the fire control and interceptor technologies; and demonstrate the operational utility of the system architectures through constructive and force-on-force simulations. In FY06, will begin the development and demonstration of critical supporting component fire control technologies, including acquisition and tracking sensors and decision algorithms. In FY07, will fabricate and bench and field test critical acquisition and tracking sensor components and decision algorithm technologies.	700	1000	1200	5500
- Close-In Active Protection System (CIAPS): In FY04, completed preliminary design for on-board target sensor, and purchased long-lead components for fabrication of science and technology prototype radar sensor for tactical wheeled vehicles. Transitioned this technology to PE 603313A Project D550.	4924	0	0	0
Totals	37320	34104	44824	53869

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602303A - MISSILE TECHNOLOGY**	**G02**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
G02	ARMY HYPERSONICS APPLIED RESEARCH	7891	8749	17700	11932	0	0	0	0

A. Mission Description and Budget Item Justification: This project funds applied research to research and investigate the critical technologies required to mature expendable hypersonic missiles. Focus areas include: hypersonic aerodynamic prediction tool development; scramjet engine component design; active and passive cooling mechanisms; turbulent mixing enhancement at low Reynolds numbers; computational fluid dynamic code development and validation and high yield, storable hydrogen fuel grains. Initial efforts will focus on concept maturation of Scramjet enabled missiles to enhance Army operational missions. Efforts will be conducted through detailed system and subcomponent simulation, design, maturation and test in laboratory settings. The cited work is consistent with Transformation Planning Guidance, the Army Science and Technology Master Plan (ASTMP) and the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed at the Aviation & Missile Research, Development, and Engineering Center, U.S. Army Aviation and Missile Command, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Hypersonic System Trade Studies:- In FY04, initiated system trade studies to determine the system level technical requirements associated with various air and missile defense and deep attack operational scenarios. Performed analyses of alternatives on the various missile components such as seeker, guidance and control, aerodynamic design to assess the technological shortcomings associated with a hypersonic enabled system. Estimated Initial missile sizing and mass properties based on preliminary sub-component geometry. Developed preliminary propulsion and aerodynamic estimates for notional system concepts and utilized multi-degree of freedom flyout analysis to assess system capability. Constructive simulations were also utilized to assess capability of a hypersonic enabled system in various operational scenarios. In FY05, will complete system and component level trade studies to determine missile system technical requirements addressing stated objectives for future Army air and missile defense systems and to assess the operational enhancement expected from a hypersonic enabled system. Computational fluid dynamic and high fidelity mathematical simulation analysis will be utilized in these analyses. Continue constructive simulation efforts based on preliminary design trades to further explore advantages of the proposed systems in new operational scenarios of interest. In FY06 utilize missile system and subsystem trades studies to assess system operational performance as system and subsystem technology matures and to clearly identify technological shortcomings that need to be addressed to weaponize the hypersonic engine technology. In FY07, will continue assessment of system operational performance. Evolving operational scenarios will be explored using constructive and engineering level simulations to assess advantages of hypersonic enabled systems.	843	1450	2000	2000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Hypersonic Engine and Missile Component Design: - In FY04, initiated design efforts for primary engine flow-path components. Investigated two specific engine designs, an annular engine design and an inward turning design. Performed computational fluid dynamic analysis to assess the impact of varying key geometric parameters on each engine component. Investigated inward turning and annular engine inlet designs along with multiple combustor length-to-diameters ratios on both engine concepts. Also investigated several fuel injection designs along with mixing enhancement devices on both engine concepts; investigated detailed nozzle geometries to maximize engine performance capability. In FY05, continue computational fluid dynamic analyses and develop initial hypersonic engine and missile component designs. Formulate and evaluate design concepts for inlets, combustor, fuel injectors, fuel mixing enhancement, thermal protection systems and other missile component technologies. and evaluate using computational methods. Complete design concepts for engine flow path subcomponents. Conduct limited lab and ground testing of selected engine component designs to validate computational methods. In FY06, engine component technology will be further evaluated in experimental testing of preliminary design concepts to assess operational capability of the component designs and to validate computational methods. These efforts will consist of experimental model design, instrumentation of experimental models, fabrication of test hardware and extensive ground test investigations of selected missile components. In FY07, continue experimental investigations of component technology to optimize the component designs as understanding of component designs improves and technologies mature. Component technology will be transitioned during FY07 to 0603313 G03.	7048	7299	15700	9932
Totals	7891	8749	17700	11932

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		14425	24495	21139	21989	22496	22964	23420	23884
042	HIGH ENERGY LASER TECHNOLOGY	13450	15148	21139	21989	22496	22964	23420	23884
NA5	ADVANCED WEAPONS COMPONENTS (CA)	975	9347	0	0	0	0	0	0

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. This PE also investigates new technology concepts in space applications. The major effort under this PE is the development of a multi-hundred kilowatt (kW) Solid State Laser (SSL) laboratory demonstration that can be integrated into a HEL weapon 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, rocket propelled grenades, 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 (especially improvised explosive devices (IEDs)) 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 Future Combat Systems (FCS) 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 that will be developed in PE 0603004A/L96. Project NA5 funds Congressional interest items. Work in this PE is related to, and fully coordinated with, efforts in PE 0602890 D8Z and PE 0603924D8Z (High Energy Laser Joint Technology Office), PE 0605605A (DOD High Energy Laser Systems Test Facility), PE 0603305A/TR3 (Army Missile Defense Systems Integration/Mobile Tactical High Energy Laser), and starting in FY06 to PE 0603004/L96 (Weapons and Munitions 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 US Army Space and Missile Defense Command (SMDC), in Huntsville, AL and the Army Test and Engineering Center, White Sands Missile Range, NM.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	16641	19589	19962
Current Budget (FY 2006/2007 PB)	24495	21139	21989
Total Adjustments	7854	1550	2027
Net of Program/Database Changes			
Congressional Program Reductions	-1191		
Congressional Rescissions			
Congressional Increases	9750		
Reprogrammings			
SBIR/STTR Transfer	-705		
Adjustments to Budget Years		1550	2027

Change Summary Explanation:
FY06 - Increased funding ($1550K) to enhance Applied Research in Space Technology.
FY07 - Increased funding ($2027K) to enhance Applied Research in Space Technology.

Two FY05 Congressional Adds totaling $9750 were added to this PE.

FY05 Congressional Adds with no R-2A:
($3117) Army Missile and Space Technology Initiative, Project NA5: The purpose of this one year Congressional add is to develop a Government standard Hypersonic Computational Fluid Dynamics Model for evaluating PEO ASMD future Cruise Missile and Theater Missile defense concepts. No additional funding is required to complete this project.

($6233) Rapid Targeting Acquisition and Tracking System (RTATS), Project NA5: The purpose of this one year Congressional add is to enable a demonstration of the RTATS on targets such as rockets, artillery, mortar, and Anti-Tank Guided Missiles to accuracies needed to support a Solid State Laser Weapon. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
042	HIGH ENERGY LASER TECHNOLOGY	13450	15148	21139	21989	22496	22964	23420	23884

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. This project also investigates new technology concepts in space applications. The major effort under this project is the development of a multi-hundred kilowatt (kW) Solid State Laser (SSL) laboratory demonstration that can be integrated into a HEL weapon 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, rocket propelled grenades, 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 (especially improvised explosive devices (IEDs)) 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 Future Combat Systems (FCS) 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 that will be developed in PE 0603004A/L96. Work in this project is related to, and fully coordinated with, efforts in PE 0602890 D8Z and PE 0603924D8Z (High Energy Laser Joint Technology Office), PE 0605605A (DOD High Energy Laser Systems Test Facility), PE 0603305A/TR3 (Army Missile Defense Systems Integration/Mobile Tactical High Energy Laser), and starting in FY06 to PE 0603004/L96 (Weapons and Munitions 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 US Army Space and Missile Defense Command (SMDC), in Huntsville, AL and the Army Test and Engineering Center, White Sands Missile Range, NM.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Solid State Laser (SSL) Development, Phase 1 – 25kW: In FY04, assembled and demonstrated 32kW of laser power out of a 4-module, diode-pumped Solid State Heat Capacity Laser (SSHCL) breadboard using 10-cm square laser slabs. Modified intra-cavity active resonator and conducted laboratory characterization of the diode-pumped laser device to include thermal cycling time, power management requirements, and beam quality. Demonstrated the major aspects of power scaling and beam combining/quality/efficiency. In FY05, integrate the intra-cavity resonator and sliding laser disk thermal management concept into the SSHCL breadboard design to improve run-time performance. Analyze results of competitive 25 kW Joint High Power SOlid State Laser (JHPSSL) Program laboratory demonstrations and independent Government testing; down select best SSL design, and initiate development of a 100kW SSL laboratory device.	9680	12248	0	0
SSL Subcomponent Development: - Laser crystal development - In FY04, reliably produced laser crystals, maintaining state-of-the-art crystal dislocation density while increasing crystal size from 8 to 10 cm square. In FY05, procure and test optical and thermal properties of high quality ceramic slabs as an alternative crystal material. In FY06, will procure and test large, high quality, ceramic crystal slabs that are 8 to 10 cm square. - Thermal management - In FY04, demonstrated a scaled version of a thermal management system designed for the SSHCL breadboard. Designed, demonstrated and validated the feasibility of a novel sliding laser disk thermal management concept to reduce SSHCL run-time limitations. In FY06, will integrate ceramic test slabs into laser breadboard and evaluate impact on thermal properties of the laser system. - - Laser diode development – In FY04, initiated an industrial effort to enable area scaling (monolithic array) of laser diode/cooler package, which enables the processing of multiple diode bars per cooler and reduces manpower requirements for assembly, thereby significantly reducing manufacturing costs. In FY06, will procure and fabricate laser diode arrays for the 100kW laboratory laser breadboard. - Beam quality technologies - In FY05, develop and test advanced resonator concepts to improve beam quality.	3770	1100	1200	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Solid State Laser Effects: - Laser Lethality and Propagation Assessments - In FY05, expand lethality assessment to include representative threat system components. Use the flash-lamp pumped demonstrator at HELSTF to assess propagation effectiveness of the SSL wavelength through at least 500 m of atmosphere. In FY06, will continue laser propagation and lethality studies at tactical ranges both at HELSTF and other test facilities using SSLs. In FY07, will conduct lethality assessments on an expanded target set representative of identified capability gaps. - Laser Modeling and Simulation – In FY05, enhance on-going High Energy laser Joint Technology Office efforts in establishing a DoD-wide validated M&S capability for effectively modeling SSL technology. In FY06, will initiate the development and validation of performance and propagation models for Solid State Lasers in a tactical environment. In FY07, will begin integration of validated models into approved Army war-gaming models.	0	1800	1500	1500
SSL Development, Phase 2 – 100kW: In FY06, will procure long lead items and begin integration of components into subsystems that form the basis of a 100kW laboratory laser device that meets the JHPSSL Program Phase 2 performance goals. In FY07, will fabricate remaining components; integrate subsystems into a laser breadboard and conduct preliminary performance tests with an intermediate goal of achieving a 60kW laser output with good beam quality.	0	0	15339	17289
Advanced Laser Concepts: In FY06, will initiate concept exploration into novel laser concepts that stress high efficiency and low weight. In FY07, will initiate concept exploration into monolithic high brightness diode/diode laser capabilities for tactical applications.	0	0	1550	1600
Space Application Concepts: In FY06, will initiate unique intelligence, surveillance, reconnaissance, missile warning, battle management, and communications technologies leveraging the Joint Warfighting Space / Tactical Satellite (JWS/TacSat) Demonstration efforts to validate Army space force enhancement needs. In FY07, will continue space payload/technology investigations to support cooperative Hyperspectral Imaging (HSI), Synthetic Aperture Radar (SAR), and Blue Force Tracking (BFT) payload development for experimentation in the JWS/TacSat initiative.	0	0	1550	1600
Totals	13450	15148	21139	21989

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		30153	22721	16013	16858	17104	17481	17827	18182
C90	ADVANCED DISTRIBUTED SIMULATION	10068	9843	10586	10921	11035	11289	11513	11742
D01	PHOTONICS RESEARCH	4870	3356	0	0	0	0	0	0
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	4989	4633	5427	5937	6069	6192	6314	6440
D14	ADVANCED MODELING AND SIMULATION INITIATIVES (CA)	7791	4889	0	0	0	0	0	0
HB4	IMMERSIVE ENVIRONMENT APPLIED RSCH INITIATIVE (CA)	2435	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element conducts applied research in modeling and simulation technologies for application to training and evaluation of the Future Combat Systems (FCS), the Future Force (FF), and where feasible, 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 and training evaluation 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, such as immersive training, leadership development, and concept exploration. This environment will help the Army to investigate and refine new warfighting concepts, including the 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 maturing 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 will ensure the transition of the research results of the ICT into the Army technology base and future Army training products. Projects D01, D14, and HB4 fund Congressional special interest items. This program is fully coordinated with other Army applied research programs, the Defense Advanced Research Projects Agency (DARPA), and the Defense Modeling and Simulation Office. Results from this applied research will feed PE 0603015A (Next Generation Training & Simulation 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 PE is performed by the Research Development and Engineering Command (RDECOM), Orlando, FL.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	15041	16144	16662
Current Budget (FY 2006/2007 PB)	22721	16013	16858
Total Adjustments	7680	-131	196
Net of Program/Database Changes			
Congressional Program Reductions	-338		
Congressional Rescissions			
Congressional Increases	8600		
Reprogrammings			
SBIR/STTR Transfer	-582		
Adjustments to Budget Years		-131	196

Change Summary Explanation:

Two FY05 Congressional adds totaling $8600 were added to this PE.

FY05 Congressional Adds with no R-2A:
($4891) Joint Unmanned Systems Test and Research (JOUSTER), Project D14: The purpose of this one year Congressional add is to establish and operate the Unmanned Systems Controlled Experimental, Test and Research Facility at the Virginia Polytechnic Institute to support the cost effective and timely evaluation and development of military autonomous vehicle systems. No additional funding is required to complete this project.

($3357) University Photonics Research, D01: The purpose of this one year Congressional add is to manufacture, assemble and characterize optical components and laser output for a unique fiber laser combiner. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
C90	ADVANCED DISTRIBUTED SIMULATION	10068	9843	10586	10921	11035	11289	11513	11742

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 will enhance 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. 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), Orlando, FL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Live, Virtual, Constructive Simulations: In FY04, prototyped an environmental data model to represent urban terrain structures in high resolution environments enabling realistic dismounted soldier training, mission rehearsal, and analysis capability in future virtual environments; and analyzed magnetic fluid Inertial Measurement Unit (IMU) sensor for use in obtaining enhanced position/navigation information of soldiers and vehicles during operations and training in urban environments. In FY05, enhance modeling of unconventional threats in complex virtual urban environments; develop breadboard instrumentation using IMU sensor to improve performance of tactical engagement simulation systems for test and training; and increase constructive simulation realism by developing single-processor Graphics Processing Unit (GPU) software architecture and coprocessor algorithms to overcome current constructive simulation computational bottlenecks. In FY06, will establish a standard toolset for high-resolution urban environment development and increase interoperability of multi-service virtual simulations networked with live systems in training environments; will miniaturize prototype instrumentation system with IMU sensor to demonstrate full position/navigation and tracking capabilities at the Military Operations in Urban Terrain (MOUT) test site; and will develop multiple GPU cluster architecture using algorithms from GPU coprocessor research. In FY07, will extend research of alternative data sources from Corps of Engineers to rapidly develop urban environments for training, mission planning and rehearsal to reduce the dependence on training specific databases; will reduce size, weight, and power consumption of the IMU sensor and software GPS receiver to permit embedment into small arms weapons and the Joint Tactical Radio System; and will prototype Army Constructive Training Federation using multiple GPU architecture.	2609	3750	3894	3867

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Modeling and Simulation Training Technologies. In FY04, matured concepts for field deployable patient simulators to provide clinically accurate training in realistic combat environments; prototyped a virtual reality based dismounted embedded training system; investigated augmented reality technologies that merge simulated entities with virtual graphics to provide the soldier an enhanced real world representation; developed wireless command and control concepts for medical simulation suites; and integrated robotic sensor suites and intelligent survivability behaviors on platforms and demonstrated control capability. In FY05, enhance patient simulator by incorporating realistic skin, physiologically accurate injuries, sensors, and miniaturization technologies; develop a prototype dismounted soldier training system to demonstrate augmented reality in a full-immersive combined arms training environment; and develop models to facilitate the assessment of the effectiveness of mixed teams. In FY06, will integrate a patient simulator into a distributed simulation infrastructure at a live training center to demonstrate the seamless transfer of patient data and the modeling of geographically dispersed levels of care; will evaluate a field capable dismounted embedded training system integrated with a FCS surrogate to demonstrate deployable collective training and distributed action review (AAR) technologies; will mature deployable human wearable augmented reality training technologies; and will develop tools to evaluate mixed human-intelligent agent team performance. In FY07, will increase the effectiveness of distributed medical simulation supported training by integrating advances in wound simulation and physiological modeling; will investigate the usability of flexible display technologies and the application of nano-sensors embedded in the Soldiers' clothing and weapon systems; and will develop intelligent and adaptive behaviors to represent autonomous systems to enhance t	4730	3521	3771	3778

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Collaborative and Immersive Environment Technologies. In FY04, began maturing tools to develop training environments and scenarios in an Internet-based asymmetric warfare virtual training technology (AWVTT) environment; performed user evaluations with the Illinois Army National Guard; and prototyped test-beds for distributed component simulations to support the training missions of the Future Force (FF) to include Future Combat Systems (FCS) and dismounted warrior systems. In FY05, continue to develop new behaviors in the One Semi-Automated Forces (OneSAF) Objective System (OOS) baseline and begin developing the linkages between the AWVTT and the OOS; perform user evaluations with combat units; and expand our understanding of the student learner model to identify aspects of learning scenarios that will facilitate the enhancement of virtual learning environments. In FY06, will complete development of the tools required for a trainer to develop new types of asymmetric warfare training scenarios; and will use the student learner model to evaluate the effectiveness of the single-user training module for immersive training. In FY07, will research and prototype a distributed fully immersive asymmetric warfare virtual training environment for the FF and FCS; and will conduct experiments to validate the metrics, tools, and methods of the single-user framework and extend the single-user framework to accommodate multi-user small team collaborative requirements.	2729	2572	2921	3276
Totals	10068	9843	10586	10921

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	4989	4633	5427	5937	6069	6192	6314	6440

A. Mission Description and Budget Item Justification: This project enables the transfer and maturation of simulation and training research results to the Army from PE 0601104, Project J08 (Institute for Creative Technologies). Goal 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, such as immersive training, leadership development, and concept exploration; by creating a true synthesis of creativity and technology by leveraging the capabilities of industry and the 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 this goal requires research in techniques and methods for integrating different sensory cues into virtual environments to enhance 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. 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), Orlando, FL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Immersive Technology Environments. In FY04, created solutions and matured research for the shortfalls in human to virtual human interactions. In FY05, investigate verbal communications techniques for virtual human interactions with soldiers; and examine the concept of an integrated learning environment framework and identify interdependences to increase the realism of immersive environments used for training. In FY06, will investigate nonverbal communications techniques for virtual human interactions with soldiers; and will integrate the representations of selectable ethnicity and situational impact of emotions into the human to virtual human interaction. In FY07, will integrate enhanced virtual humans into leader training exercises and advanced technology demonstrations in collaboration with TRADOC; and will mature virtual human research utilizing feedback from evaluations to support self-guided and self-directed training.	2267	2171	2538	2682

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Immersive Technology Techniques. In FY04, demonstrated photo-realistic rendering of human faces and integrated this into immersive environments; integrated audio and sensing cues algorithms and techniques into the immersive environments to investigate emotional responses for increased realism during training; and demonstrated laser-scanned environment in immersive virtual reality system. In FY05, begin developing single-user learning environment integrating advanced computer generated coaching and mentoring tools (artificial intelligence) into an immersive simulation environment; begin to develop the tool sets that will allow training developers to rapidly create relevant immersive learning scenarios; mature and demonstrate next generation global illumination algorithms and facilitate their adoption into military training applications. In FY06, will complete development of single-user learning environment; will begin usability and effectiveness testing of single-user prototype; will create computer-based opposing forces in a simulation that learns to improve its behavior from observations of others and by analyzing its own mistakes; will develop new programming technology that allows a system to be self-documenting by explaining its reasoning and how it works in easily understood English; and will integrate captured photo-real human characters into a real-time simulation. In FY07, begin developing multi-user learning environment integrating advanced computer generated coaching and mentoring tools (artificial intelligence) into an immersive simulation environment; will investigate concepts and begin to develop the tool sets that will allow training developers to rapidly create relevant immersive learning scenarios; will advance and incorporate explainable artificial intelligence technology in computer coaches that provide advice and corrections to learners as they use training systems; and will provide improvements to rapid simulation development tools.	2722	2462	2889	3255
Totals	4989	4633	5427	5937

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		114340	114108	64883	66668	63263	56814	57307	57726
C05	ARMOR APPLIED RESEARCH	18794	14223	9907	10185	10623	10743	10836	10915
H77	ADV AUTOMOTIVE TECH	55032	49006	15879	15982	16531	16716	16862	16985
H91	TANK & AUTOMOTIVE TECH	26343	32759	39097	40501	36109	29355	29609	29826
T26	GROUND VEHICLE TECHNOLOGIES (CA)	14171	18120	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element (PE) researches, investigates and applies combat vehicle and automotive component technologies that will improve survivability, mobility, sustainability, and maintainability of Army ground combat vehicles. As combat vehicle systems become smaller and lighter to provide the necessary strategic deployability and tactical mobility, 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, multi-spectral signature reduction, Active Protection (AP) systems and advanced lightweight armor in place of heavy conventional armor. Project C05 focuses on designing an integrated lightweight armor suite of protection against Chemical Energy (CE) and medium Kinetic Energy (KE) threats with less than one fourth the weight burden of conventional heavy armor. Goals are to provide lightweight structural armor at 20 lb/sq.ft. (or less) to defeat heavy machine gun threats and frontal armor at 60 lb/sq.ft. (or less) to protect against more severe threats. 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, pursuing automotive-oriented technology programs that have potential benefit to military ground vehicles. Project H91 is investigating, evaluating and characterizing unique AP countermeasure warheads for intercepting CE and KE threats. Project H91 also investigates hybrid electric propulsion and electronic vehicle component technologies, which are key enablers for achieving Future Combat Systems (FCS) and Future Force capabilities. In the near term, FCS vehicles will be designed with hybrid electric architectures, providing power for propulsion, communications and control systems, life support systems, and electromagnetic (EM) armor. In the farther term, vehicle energy and power levels will be increased to accommodate advanced electric weapons (such as lasers, high power microwaves and electric guns) and advanced electric-based protection systems. Project H91 provides components for improved vehicle performance and mobility, including active suspensions, motors, regenerative brakes, vehicle electronics (VETRONICS), generators, controllers, hybrid electric architectures, inverters and lightweight track. It also investigates and matures high temperature/power electronics, high energy density energy storage devices, and components of Pulse Forming Networks (PFNs) (such as batteries, switches, inductors and capacitors) required for electric vehicle mobility and survivability. In addition Project H91 addresses sustainability and maintainability, with efforts in advanced military fuels and lubricants; vehicle diagnostics; and on-vehicle water generation and water purification. This project also addresses the systematic integration and assessment of these technologies in lightweight conceptual platforms using advanced virtual prototyping capabilities. Project T26 funds Congressional special interest items. The PE is coordinated with the Marine Corps through the Naval Surface Warfare Center and with other ground vehicle developers within 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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	69638	71287	71005
Current Budget (FY 2006/2007 PB)	114108	64883	66668
Total Adjustments	44470	-6404	-4337
Net of Program/Database Changes			
Congressional Program Reductions	-1680		
Congressional Rescissions			
Congressional Increases	48700		
Reprogrammings			
SBIR/STTR Transfer	-2550		
Adjustments to Budget Years		-6404	-4337

Change Summary Explanation:

Twenty-four FY05 Congressional adds totaling $48700 were added to this PE.

FY05 Congressional adds with no R-2A:
($1438) Advanced Electric Drive, Project T26: This one-year Congressional add is to evaluate the potential impact of advanced electric drive technologies on vehicle performance, fuel economy & life-cycle costs, focusing on validation of hardware drive train configuration and hybrid control strategies. No additional funds are required to complete this project.

($7192) Advanced High Power Rechargeable Stored Energy Technology, Project T26: This one-year Congressional add is to advance the state of the art of lithium-ion batteries and ultra-capacitors that use affordable, high performance carbide, nitride, and metal alloy nano-composite materials with the appropriate power electronics, suitable for operations in temperature extremes for application to a modular hybrid electric vehicle power train. No additional funds are required to complete this project.

($959) Affordable, Low Temperature, High Performance Advanced Rechargeable Stored Energy Device Technologies for Future Army Combat Hybrid Electric Vehicles, Project T26: This one-year Congressional add is for the evaluation of advanced Li-ion battery systems No additional funds are required to complete this project.

($959) Compact Pulsed Power for Defense Applications, Project T26: This one-year Congressional add is to investigate a promising approach to pulse power storage and conditioning for military vehicles and other defense applications. No additional funds are required to complete this project.

($959) Mobile Thermal Perimeter Surveillance System, Project T26: This one-year Congressional add is to investigate technologies that will utilize thermal imaging properties for a perimeter surveillance system. No additional funds are required to complete this project.

($3836) Nano-Engineered Materials for High Performance Armor, Project T26: This one-year Congressional add is to conduct research in transparent materials for armor, consisting of investigations in processing and analysis of nano-ceramics. No additional funds are required to complete this project.

($959) Stoichiometric Explosive Detector System, Project T26: This one-year Congressional add is to perform research in the area of "bomb sniffing" technology for the Smart Truck III. No additional funds are required to complete this project.

($1823) Unmanned Vehicle Control Technologies, Project T26: This one-year Congressional add is to explore intelligent software solutions that may facilitate adjustably autonomous robotic control. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
C05	ARMOR APPLIED RESEARCH	18794	14223	9907	10185	10623	10743	10836	10915

A. Mission Description and Budget Item Justification: This project investigates, designs and develops advanced armor materials, advanced structural armors ballistic defeat mechanisms, and armor packaging solutions to achieve lightweight, ballistically-superior armors/structures that will provide the last line of defense for Future Combat Systems (FCS) and Future Force vehicles. The effort also provides for analysis, modeling, and characterization of advanced armor solutions designed to protect against collateral damage from residual debris generated by the Active Protection (AP) threat defeat mechanisms. The major focus is on providing technology solutions 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. 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, initially at 80 lb/sq.ft. (or less) for FCS - reducing this to 60 lb/sq.ft. (or less) for future FCS spiral insertion/upgrades. The armor technologies designed and fabricated in this project complement innovative non-armor survivability component techniques that are funded in Project H91. In addition this project investigates low-burden solutions for the protection of current and tactical vehicles operating in war and operations-other-than-war, focusing on appliqué armor for protection from small arms and land mines (countermine applications). International cooperative research in mine blast characterization and vehicle response is also conducted. Efforts are fully coordinated and complementary to work performed under PE 0602618A (Ballistic Technology) and PE 0602105A (Materials Technology). Ballistic protection technologies developed under this project will be evaluated and incorporated into the Integrated Survivability Advanced Technology Demonstration (ATD) in PE 0603005A (Combat Vehicle and Advanced Automotive Technology). The goal of the IS ATD is to provide “convincing evidence” of the superiority of a “layered” approach to 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 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 2004	FY 2005	FY 2006	FY 2007
Advanced Armor: In FY04, investigated advanced armor solutions to protect from residual debris associated with AP threat defeat events, meeting the intermediate frontal weight efficiency goal (80lbs/sq.ft.); provided 1st generation electromagnetic (EM) armor solutions for defeat of medium CE weapons; evaluated 2nd generation EM armor solutions that address large CE threats and meet the intermediate weight efficiency goal of 80 lbs/sq.ft. In FY05, evaluate the FCS armor prototype (AX-1), in conjunction with the Integrated Survivability ATD demonstration to determine effectiveness when used with CE AP system. In FY06, will evaluate FCS armor prototype, in conjunction with field demonstrations of the static KE AP system and Close-In AP system, to determine if the structural armor package can withstand the residuals after AP intercept. In FY07, will complete FCS armor prototype ballistic evaluation and optimize advanced passive armors developed for small arms, medium KE, and fragment defeat; will evaluate and ballistically test 4th generation armor/structure candidate solutions.	13981	11091	6118	7446
Structural Armors: In FY04, built representative vehicle armor/structure sections as ballistic targets and conducted ballistic tests using FCS objective threats, and evaluated results of armor/structural capability at FCS vehicle design weights; evaluated integration of critical armor components; investigated armor/structural reliability; evaluated electromagnetic (EM) armor components for structural armor applications; improved physics and engineering based models and design tools. In FY05, conduct ballistic range tests to optimize and validate the best achievable integrated armor packages for lightweight combat vehicle platforms, including defeat of advanced RPG and future medium cannon KE projectiles; complete design and fabrication of advanced full scale ballistic structure/platform.	3058	2254	0	0
Countermine: In FY04 investigated and developed active and passive armor appliqués that can be added onto the structure platform to enhance blast protection levels; conducted structural design studies and trades to better understand blast effects against various lower chassis design concepts; enhanced finite element modeling incorporating human occupation and seating; published assessment of alternative technologies and weight allocations for FCS platforms to defeat side attack mines, improvised explosive devices (IEDs), and penetration type mines. In FY05, refine design and reduce weight of kit protection concepts, evaluate mine resistance capabilities of developed FCS concept vehicles; collect live fire test data from mine strikes and model reactions against FCS concepts. In FY06, will demonstrate final add-on kit mine resistance solutions and experimentally validate developed blast models. In FY07, will demo improved lightweight blast/fragmentation appliqués for tactical and current force combat vehicle use with live-fire testing.	1755	878	500	500

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Full Dimensional Ballistic Protection: In FY06, explore integration issues between ballistic, signature management, and related survivability technologies, considering durability, mounting approaches, performance synergy and compatibility. Collect and analyze data in support of characterization of visual signature for operational analysis. In FY07, conduct experiments to determine the best solutions integrating ballistic, signature management, and related survivability technologies, initiate visual signature characterization algorithm development and execute supporting perception experiments.	0	0	3289	2239
Totals	18794	14223	9907	10185

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H77	ADV AUTOMOTIVE TECH	55032	49006	15879	15982	16531	16716	16862	16985

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 that focus on benefiting military ground vehicle systems. Component technologies being researched and investigated in this project support the Army's current and future combat and tactical vehicle fleets. 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 vehicles and light combat vehicles to improve fuel economy and mobility. This area also includes other fuel efficiency technologies, vehicle modernization, crew safety, maintenance, reliability, diagnostics and prognostics, 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. Another major effort in ATT is fuel cell research, addressing both fuel cells and the equipment (re-formers) required to convert battlefield fuels to substances that a fuel cell needs to operate. The FTTS ACTD will incorporate a number of advanced automotive technologies that the Army and commercial sector have been maturing in recent years into tactical support vehicles for the FCS and the Future Force. The ACTD will provide a number of FTTS demonstrator vehicles for evaluation in a military unit field environment. ACTD test results will validate FTTS modeling estimates, refine FTTS User requirements, reduce the FTTS program risk and reduce risk of technology transfer to current platforms. Additional funds for the ACTD are contained in PE 0603005A, Project 440 (Advanced Combat Vehicle Technology). Some activities of the NAC are supported by other government agencies via a Memorandum of Agreements (MOA) and Memorandum of Understandings (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 2004	FY 2005	FY 2006	FY 2007
Advanced Automotive Technology: In FY 04, continued Commercially Based Tactical Trucks (COMBATT) and Hybrid Electric COMBATT tests; updated Hybrid Electric (HE) design configuration and associated test for the Heavy Expanded Mobility Tactical Truck (HEMTT); instrumented the HEMTT ESP hydraulics with diagnostic sensors; tested concept vehicle (HE M113); developed/demonstrated enhanced vehicle power train for light tactical vehicles, worked with Project Manager (PM), Tactical Wheeled Vehicles to develop and implement a Risk Mitigation program for test, evaluation and manufacture of Re-Powered Light Tactical Vehicles (LTV). In FY05, test advanced propulsion systems/HE for light tactical vehicles; evaluate Hybrid Hydraulic (HH) systems on medium/heavy tactical vehicles; conduct test/ evaluation of subsystems and components comprising hybrid electric propulsion systems in ground vehicles; test HH Propulsion demonstrator; test HEMTT A3 Chassis and Independent Active Suspension Test Rig Component; test reliability & performance of COMBATT vehicles at the Severe Off-Road Vehicle Track; support PM, Tactical Vehicles in vehicle test/evaluation for Re-Powered Light Tactical Vehicles. In FY06, conduct developmental/operational test of Re-power LTV; conduct joint military operation/evaluation of SmarTruck tactical vehicle assessment of capabilities for Homeland Defense/Security automotive needs; continue technology integration/evaluation of hybrid powertrain technologies for M113 vehicles, focusing, on the Command Vehicle. In FY07, continue to conduct developmental/operational test of Re-power LTV; continue to conduct joint military operation/evaluation of SmarTruck tactical vehicle assessment of capabilities for Homeland Defense/Security automotive needs; continue technology integration/evaluation of hybrid powertrain technologies for M113 vehicles, focusing, on the Command Vehicle.	11644	11938	14879	14982

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Future Tactical Truck System (FTTS) ACTD: In FY04, awarded multiple contracts for key component technology selections and subsystem designs through Modeling and Simulation (M&S) of the Maneuver Sustainment Variant (MSV) and the Utility Variant (UV) vehicles; selected contractors to utilize M&S tools to analyze and optimize the MSV and UV vehicle concept design; conducted M&S efforts focused on the Hybrid powertrain, energy/power management, material handling, mobility, and ease of vehicle maintenance; defined and evaluated design, performance and operational trade space throughout the M&S cycle; used contractor test results of key subsystems and components to validate modeling results; held preliminary design reviews; in September awarded two M&S contracts to provide analysis for: mobility, Material Handling Equipment (MHE), physical architecture assessment, weight, concepts, transportability, operational effectiveness, cost, and pit stop design. In FY05, award up to four additional M&S contracts for the Utility Variant (UV); select contractor(s) to continue based on down select criteria; purchase vehicle hardware for demonstration. In FY06, will evaluate the vehicles to validate the M&S predictions of the performance and military utility of the MSVs and UVs; perform virtual prototyping and mobility modeling through the use of 3D models and analysis. In FY07, will support the user evaluation of the vehicles.	10299	9014	1000	1000
Mobility Vehicle Design: In FY04, established baseline 42V power generation, energy storage devices, and smart power architecture components; curtailed efforts since commercial sector abandoned the move to 42V standard.	500	0	0	0
Advanced Energy & Manufacturing Technology: This one-year Congressional add researched automotive power technologies for possible application in military land warfare systems. No additional funds are required to complete this effort.	2025	0	0	0
Advanced Electric Drive: This one-year Congressional add evaluated the potential impact of Advanced Electrical Drive Technologies on vehicle performance, fuel economy and life-cycle costs. No additional funds are required to complete this effort.	1156	0	0	0
Advanced Manufacture of Lightweight Materials (AMLM): This one-year Congressional add focused on development of advanced lightweight materials for applications in military and commercial vehicles. No additional funds are required to complete this effort.	482	0	0	0
CALSTART Defense Advanced Trans: This one-year Congressional add facilitated joint programs and communication between the DOD, the private sector, and state and regional governments to develop advanced heavy-duty vehicle technologies focused on hybrid drive trains and fuel cells. No additional funds are required to complete this effort.	4918	0	0	0
Digital Humans & Virtual Reality: This one-year Congressional add designed tools for the analysis, optimization, and simulation of the human interface for current and evolving vehicle systems. No additional funds are required to complete this effort.	964	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Future Tactical Truck System (FTTS) Companion Trailer System(s): This one-year Congressional add funded research and development of a trailer to follow behind the FTTS. No additional funds are required to complete this effort.	1639	0	0	0
Hydrogen PEM Fuel Cell Heavy Duty: This one-year Congressional add researched building a vehicle power plant to undergo durability testing and conduct product improvement redesign effort based on the test results. No additional funds are required to complete this effort.	2411	0	0	0
Hydrogen PEM Ambient Pressure Fuel Cell Demonstration: This one-year Congressional add assembled a prototype proton exchange membrane (PEM) vehicle power plant for evaluation. No additional funds are required to complete this effort.	3278	0	0	0
Fuel Efficiency Technology: This one-year Congressional investigated a pre-reforming concept for processing logistic fuels used in ground vehicle fuel cell auxiliary power units. No additional funds are required to complete this effort.	964	0	0	0
Next Generation Smart Truck: This one-year Congressional add tested automotive technologies for military and homeland security/counterterrorism applications. No additional funds are required to complete this effort.	4146	0	0	0
Army Truck Diagnostic System: This one-year Congressional investigated existing commercial vehicle electronics technologies that might be leveraged into Army tactical trucks and/or combat platforms to enhance capabilities. No additional funds are required to complete this effort.	1639	0	0	0
Auragen Vehicle Integrated Primary Electrical Resource (VIPER): This one-year Congressional add researched under-hood power generating systems capable of producing 3-12 kilowatts of AC power compatible with combat and tactical vehicles with a drive system. No additional funds are required to complete this effort.	3375	0	0	0
M-Gator Improvements: This one-year Congressional add investigated improved electric and hybrid-electric drivetrains for the John Deere M-Gator series of ultra light mobility platforms. No additional funds are required to complete this effort.	964	0	0	0
Rapid Prototyping Technologies: This one-year Congressional add designed a metal spray system. No additional funds are required to complete this effort.	1350	0	0	0
Unmanned Vehicle Control Technologies: This one-year Congressional add studied improved control of unmanned vehicles and investigated human and vehicle interfaces. No additional funds are required to complete this effort.	1639	0	0	0
Military Wheeled Vehicle Electronic Architecture Integration: This one-year Congressional add investigated existing commercial software and hardware technologies that might interface with Army tactical truck electronic architectures to facilitate the movement and manipulation of on-board data. No additional funds are required to complete this effort.	1639	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Energy & Manufacturing Stored Energy Technology: This one-year Congressional add is to evaluate the feasibility of incorporating advanced power technologies into military land warfare systems, to include the legacy, interim, and objective force vehicles. No additional funds are required to complete this project.	0	2068	0	0
SmarTruck: This one-year Congressional add is to provide various vehicle platforms to test, integrate, and to showcase cutting-edge automotive technologies with military and homeland security/counter terrorism applications. No additional funds are required to complete this project.	0	4039	0	0
Military Wheeled Vehicle Electronic Architecture Integration: This one-year Congressional add is to investigate software (including Movement Tracking Systems SW functionality) interfaces for military vehicle situational awareness, maintenance, and logistics reporting. No additional funds are required to complete this project.	0	2440	0	0
Rapid Prototypeing: This one-year Congressional add is to research a soldier friendly re-manufacturing software suite and a robust metal spray deposition system. No additional funds are required to complete this project.	0	1406	0	0
CALSTART Defense Advanced Transportation Technology Program: This one-year Congressional add is to facilitate the development of commercial hybrid trucks, support the Hybrid Truck Users Forum, and assist in the accelerated development of hybrid electric vehicles. No additional funds are required to complete this project.	0	937	0	0
Army Trailer Technology Insertion (TTI): This one-year Congressional add is to investigate and evaluate suspension systems, propulsion alternative, pintle alternatives, material options and power source methodologies for the Future Tactical Companion Trailer. No additional funds are required to complete this project.	0	2392	0	0
Center for Tribology and Coatings: This one-year Congressional add is to investigate new coating technologies to legacy and future vehicle systems. No additional funds are required to complete this project.	0	1406	0	0
Distributed Transportable Synthetic Fuel Manufacturing Modules: This one-year Congressional add is to develop conceptual microchannel process technology reactor design for the third step of synthetic fuel manufacturing (hrdrocracking). No additional funds are required to complete this project.	0	1406	0	0
Flexible JP-8 (Single Battlefield Fuel) Pilot Plant Program: This one-year Congressional add is to continue the investigation into the use of synthetic and investigate the feasibility of a modular fuel plant that would produce synthetic fuel in-theater, using existing stranded natural gas reserves. No additional funds are required to complete this project.	0	4218	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Future Hybrid Vehicle Systems: This one-year Congressional add is to develop and commercialize M&S tools and applications, supporting the development of Future Hybrid Vehicle Systems. No additional funds are required to complete this project.	0	1406	0	0
Light Utility Vehicles: This one-year Congressional add is to continue follow-on fuel cell ATV development. No additional funds are required to complete this project.	0	2215	0	0
Multipurpose Utility Vehicle-Reconfigurable: This one-year Congressional add is to investigate a smaller, lighter, more versatile, more maneuverable internally transportable tactical vehicle which could be used in deployments throughout the world. No additional funds are required to complete this project.	0	1310	0	0
Unmanned Vehicles Surveillance & Sensor System: This one-year Congressional add is to research intelligent software solutions that may facilitate adjustable autonomous robotic control. No additional funds are required to complete this project.	0	937	0	0
Wireless Sensors for Vehicle Maintenance: This one-year Congressional add is to research for wireless sensors that apply to diagnostics/prognostics and logistics functions. No additional funds are required to complete this project.	0	937	0	0
Advanced Vehicle Life Consumption and Maintenance Prognostic System: This one-year Congressional add is to collect data and analyze the fatigue life of selected components/subsystems of the Stryker ICV (1-6 vehicles). No additional funds are required to complete this project.	0	937	0	0
Totals	55032	49006	15879	15982

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H91	TANK & AUTOMOTIVE TECH	26343	32759	39097	40501	36109	29355	29609	29826

A. Mission Description and Budget Item Justification: This project researches, investigates, and evaluates innovative vehicle concepts, mobility, power, propulsion, survivability, and other component technologies for application to current and future combat vehicles and capability upgrades to current vehicles. The project also addresses water generation, recovery and purification as well as military fuels and lubricants. Hybrid Electric and Electric Vehicle technologies are key enablers for achieving Future Combat Systems (FCS) Future Force capabilities and bringing critical platform enhancements to current platforms through upgrades. Future combat vehicles are being designed with hybrid electric architectures, providing power for propulsion, communications and control systems, survivability and leathality. The Hybrid Electric/Electric Vehicle effort designs, fabricates and evaluates critical components for energy storage and power distribution and management. Components developed under this effort are often incorporated into the Power & Energy (P&E) Systems Integration Laboratory and the Mobile Dynamic Test Rig (both funded in PE 0603005A, Project 441 (Combat Vehicle Mobility) for evaluation and systems maturation. The Pulse Power effort focuses on providing high energy/high power density components and designs of Pulse Forming Networks (PFNs), which are enablers for the advanced electric-based weapon and protection systems. These two efforts support the Office of the Secretary of Defense (OSD) Power and Energy Initiative, which is one of the top three DoD S&T priorities. The goal of the Propulsion/Prime Power effort is to design engines generators and their components with significantly improved performance characteristics and efficiencies. In the near term, increasing the power density is a key objective; in the farther term focus is on achieving even higher power densities and maturing fuel cell technology. 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 enable high OPTEMPO and to reduce logistics burdens associated with manned and unmanned combat and tactical vehicles. Work in this project is performed in collaboration with the U.S. Army Engineer Research and Development Center located at Vicksburg, Mississippi. The Vehicle Survivability effort provides component technologies that contribute to an integrated vehicle survivability approach. This effort includes design and testing of active protection and hit-avoidance components, signature reduction materials, tracking/detection components for unmanned systems, laser protection materials, and advanced lightweight structure and base armor. This work complements, but does not duplicate, work performed under the Armor Applied Research Project (C05). The Water Generation, Recovery and Purification effort focuses on reducing the logistics footprint by leveraging emerging technologies. The program will demonstrate enhanced water production technology, which can be embedded in combat platforms to support the individual soldier, and/or create distributed modular water production units. The goal is to reduce water distribution requirements (projected to be 30% of the total daily sustainment requirement of the Future Force) through three approaches: 1) innovative purification of traditional water sources; 2) water recovery from exhaust; and 3) water recovery from atmospheric humidity. Activities are closely coordinated the Army Research Laboratory (ARL) and the 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 Tank Automotive Research, Development and Engineering Center (TARDEC), Warren, MI.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Hybrid Electric/Electric Vehicle: In FY04, built and evaluated advanced high power (10kW), high temperature silicon and silicon carbide (SiC) hybrid converters; characterized performance of state-of-the-art energy storage and power generation components (advanced batteries, capacitors, switches, converters, etc.), data and incorporated validated components into the (P&E) Hardware in the Loop (SIL). In FY05, test and evaluate SiC for use in high voltage rectifiers, converters, and motor drives for a more compact hybrid power management system for FCS; demonstrate higher power/energy density in Lithium Ion (Li-ion) batteries; improve these critical technologies to enable system level integration and demonstrations; continue to characterize performance and condition additional state-of-the-art components for validation and incorporation into the P&E SIL and assess Li-Ion batteries with improved performance (fire retarding material, power/thermal management, and higher power density). In FY06, will demonstrate higher power energy converters; will enhance SiC capabilities for high voltage rectifiers, converters, and motor drives; will increase Li-ion battery power, energy densities and performance; continue to assess critical technology performance and potential and begin integration into the P&E SIL with multiple configurations to determine the optimal solution. In FY07, will validate in P&E SIL significant performance and capability enhancement of SiC components (rectifiers, converters, and motor drives) and Li-ion batteries for integration into a complete, compact hybrid power management system; demonstrate integration of components, sub-systems and systems operation at one hundred degrees centigrade without degradation to components. This is a collaborative TARDEC and ARL effort.	7475	16034	14948	15089

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Pulse Power - In FY04, investigated, designed and characterized novel silicon solid state device concepts for technologies that will allow for integration of revolutionary survivability and lethality capabilities on deployable ground combat vehicles; designed and validated high-action, fast rise-time output switches capable of State-of-the-Art (SOA) power density; investigated, developed and evaluated high-performance dielectric materials and novel packaging/manufacturing techniques to increase the energy density of SOA fast-discharge, high-voltage capacitors; fabricated and evaluated SOA high-power density power converters. In FY05, investigate and evaluate SiC solid state device concepts for improved output switches and for reduced size pulse charger inverter/rectifier circuits; mature high-performance dielectric materials to further increase the energy density of fast-discharge, high-voltage capacitors; develop novel, modular silicon solid-state output switch concepts; investigate and evaluate advanced thermal management approaches for high temperature operation. In FY06, will significantly enhance the capabilities of modular SiC solid state switches while reducing the size of pulse charger inverter/rectifier circuits; will continue to increase the energy density of fast-discharge, high-voltage capacitors; and will design and develop advanced high temperature thermal management techniques. In FY07, will achieve 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. This is a collaborative effort between TARDEC and ARL.	6435	5400	5463	6326

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Vehicle Concepts Modeling and Simulation (M&S): In FY04, developed enhanced physics-based mobility models for advanced manned and robotic ground vehicle platforms operating in complex and urban terrains; modeled tire, snow and 3-D soil interactions between terrain and the vehicle running in real-time in collaboration with the U.S. Army Engineer Research and Development Center in Vicksburg, MS; completed experiment on sensory mismatch effects on human performance and started pilot study on motion mitigation techniques using gridded artificial horizon; developed robotic concepts for the FCS Armed Robotic Vehicle (ARV). In FY05, enhance understanding of adverse effects and passive and active mitigation strategies of moving vehicle operations; develop method of generating real-time 3-D terrain databases from 2-D terrain elevation profiles; incorporate hybrid electric power train models into real-time mobility models and perform war fighter experiment to determine duty cycle. In FY06, will develop concepts incorporating technology improvements to the current force and spiral upgrades for FCS as well as new, innovative vehicle systems; will continue to evolve mobility models, terrain models, and motion effects mitigation techniques; perform experiments validating motion mitigation techniques concepts.	1844	1895	2984	0
Propulsion/Prime Power: In FY04, conducted full performance characteristics and 50 hour laboratory NATO durability testing for FCS candidate engine, providing a risk mitigation for achieving the volume/power requirements for the FCS vehicles. In FY05, assess remaining FCS candidate engine performance and durability to achieve the full 6 hp/cu.ft. System power density in a 4-cylinder configuration and begin investigation of alternate engine concepts to produce an 8 hp/cu.ft. power density propulsion system.	1786	1448	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Vehicle Survivability (Active Protection/Minefield Clearance/Laser Protection/Hit Avoidance): In FY04, determined optimum ground pressure to trigger recently emplaced, as well as age-affected, mines; finalized surrogate instrumented mine configuration and subsurface ground pressure measurement devices; validated blast models with current test data to ensure accurate results; and developed preliminary designs for a laser-protected targeting sight using highly modified digital camera technology as the primary sensor. In FY05, evaluate lightweight materials and blast dissipation techniques to develop scalable design configurations capable of withstanding the blast effect of mines; utilize modeling and simulation to assess requirements compliance; finalize designs that meet the targeting requirements and integration plans for frequency agile protection; characterize and optimize signature management components. In FY06, complete design and fabricate prototype countermine mission modules; add GPS to the sensor fusion situational awareness system and demonstrate. Add templates for threat detection to alert uses to threats relevant to peacekeeping operations. KE Active protection alternative warhead development. In FY07, implement Fuzzy Logic based image fusion for recalibration and alignment of sensors after vibration and mechanical shock. Complete threat templates and conduct final field evaluation of Sensor Fusion system. Continue KE Active protection alternate warhead development. Evaluate existing hit avoidance technology for a regional protection concept; select subsystem concepts and develop interface/platform baseline requirements for simulation and modeling.	1453	2675	1639	2027
Mobility for Manned and Unmanned Vehicles - In FY04, evaluated and selected multiple contactors to investigate FCS compatible lightweight, automated modular gap defeat concepts for ARVs. In FY05; award multiple contracts to develop lightweight, automated modular gap defeat concepts; evaluate automated emplacement techniques and gap sensor technology; develop gap defeat models; initiate the fabrication of test components; enhance ARV mobility to ensure equivalent mobility to the manned vehicles of the future force. In FY06, will downselect to one contract to develop a breadboard prototype to demonstrate gap defeat technology. In FY07, conduct evaluation of; operational safety, improved autonomous navigation, mobility concepts, tactical behaviors for unmanned systems, and improved diagnostics/prognostics in unmanned systems.	2396	1685	2964	5736

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Water recovery/purification - In FY04, conducted a test track demonstration of water recovery from exhaust system on the NLOS-C Lancer vehicle and investigated designs for water recovery from atmospheric humidity. In FY05, will develop, fabricate, and evaluate 3 HMMWV-mounted water-from-exhaust units for field experimentation to validate system maturity, water production, and water quality; develop technology and demonstrate laboratory breadboard system to establish proof of concept for water recovery from atmospheric humidity. In FY06, will complete water-from-exhaust HMMWV field experiment; develop, fabricate, and demonstrate a water-from-air device that integrates the humidity concentration cycle with the water condensation cycle. In FY07, will develop and fabricate a water-from-exhaust system for the platform deemed most appropriate by CASCOM and PEO CS & CSS. Will develop, fabricate and evaluate in a relevant environment a water from air demonstrator.	4468	1896	4477	4516
Fuel Cell Power Initiative: In FY05, conduct laboratory assessment of the state of the art in fuel cell technology to quantify capabilities and limitations for combat vehicle power source consideration; award study contract(s) for the most power-dense conventional internal combustion and fuel cell power packages; develop COTS fuel cell and reformer modeling for early M&S validating. In FY06, will award contracts for dual approaches to desulfurization and reformer component development; will develop component requirements for proton exchange membrane and solid oxide fuel cell for Auxiliary Power Unit applications; and will advanced fuel cell stack and reformer M&S. In FY07, will select the best reformer development and desulfurization approaches and begin hardware development for evaluation.	0	1238	6622	6807
Advanced Mobile integrated Power System (AMPS): In FY04, investigated 42 Volt power generation, energy storage devices, and smart power architecture components; performed alternative concept evaluations using M&S. In FY05, adapt and refine power flexbus low power distribution and modular low power modules and investigate; and investigate smart switching power management.	486	488	0	0
Totals	26343	32759	39097	40501

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		57815	54889	49163	52168	53761	54833	52639	52783
H03	ROBOTICS TECHNOLOGY	17675	17023	15097	17682	18473	18687	16181	16060
H75	ELECTRIC GUN TECHNOLOGY	5114	4946	4802	5050	5278	5368	5414	5454
H80	BALLISTICS TECHNOLOGY	29573	27840	29264	29436	30010	30778	31044	31269
HB1	SURVIVABILITY AND LETHALITY TECHNOLOGIES (CA)	5453	5080	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element (PE) provides ballistic technologies required for armaments and armor to support the Future Combat Systems (FCS) and the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities to allow 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 of the Future Force. 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 applied research in ballistics technology to enhance the lethality and survivability of the Future Force. Focus areas include advanced solid propellants, launch and flight dynamics, weapons concepts for light forces, warheads and projectiles, armor and munition/target interactions. Projects H03 and H80 will enable lethality and survivability technologies for the Future Combat Systems (FCS). Work in this PE is related to and fully coordinated with efforts in PE 0602105 (Materials Technology), PE 0602120 (Sensors and Electronic Survivability), PE 0602601 (Combat Vehicle and Automotive Technology), PE 0602624 (Weapons and Munitions Technology), PE 0602705 (Electronics and Electronic Devices), PE 0602716 (Human Factors Engineering), PE 0602782 (Command, Control, Communications Technology), PE 0603004 (Weapons and Munitions Advanced Technology), and PE 0603005 (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).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	51301	53700	56100
Current Budget (FY 2006/2007 PB)	54889	49163	52168
Total Adjustments	3588	-4537	-3932
Net of Program/Database Changes			
Congressional Program Reductions	-765		
Congressional Rescissions			
Congressional Increases	5300		
Reprogrammings			
SBIR/STTR Transfer	-947		
Adjustments to Budget Years		-4537	-3932

Change Summary Explanation:

Three FY05 Congressional adds totaling $5300 were added to this PE.

FY05 Congressional adds with no R-2A:
($2110) Advanced Tungsten Penetrators and Ballistic Materials, Project HB1: The purpose of this one year Congressional add is to fund research in alloy tungsten armor piercing ammunition. No additional funds are required to complete this project.

($959) Guardian Angel, Project HB1: The purpose of this one year Congressional add is to fund research in ballistics technology. No additional funds are required to complete this project.

($2013) Structural Reliability of Electronic Components for Munitions and Lightweight Structures, Project HB1: The purpose of this one year Congressional add is to perform research in electronic component structures. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H03	ROBOTICS TECHNOLOGY	17675	17023	15097	17682	18473	18687	16181	16060

A. Mission Description and Budget Item Justification: This project advances autonomous mobility technology for the Future Combat Systems (FCS) and the Future Force. It will investigate robotics technology critical to the maturation of future Army systems, including unmanned elements of the FCS, 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 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 rapid implementation of near-term robotic follower technology in support of PE/Project: 63005/515, and subsequent development of both semi-autonomous and near autonomous unmanned ground vehicles (UGVs). Research is conducted at the Army Research laboratory, other DOD laboratories and research centers, NIST, NASA and DOE 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 OSD Joint Robotics Program and each of the Services. Research supports collaborative efforts with 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 2004	FY 2005	FY 2006	FY 2007
- 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 upon new sensor and sensor processing algorithms for rapid detection and classification of objects in the environment enabling 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 FY04, matured initial algorithmic structure enabling vehicles to operate in unpredictable environments, validated capability in simulation; instantiated advanced active sensor (LADAR) technology and perception algorithms required for FCS threshold mobility requirements. In FY05, insert mature perception, control, and HRI technologies onto testbed platforms to promote rapid transition of semi-autonomous capability to Future Force systems, including transfer of LADAR sensor technology to FCS program. In FY06, will conduct research enabling safe operation of semi-autonomous vehicles in populated environments, including movement in dynamic environments, e.g., oncoming traffic and pedestrians, a key barrier to the utilization of unmanned systems in future urban military operations. Research supports collaborative efforts with DARPA focused upon both near-term implementation of technologies, and incorporation of DARPA sponsored research in adaptive perception and control technology. In FY07, will conduct research to permit meaningful collaboration by autonomous vehicles (including mixed air and ground assets) utilizing the scout reconnaissance mission as the focus for technology development.	7573	7364	7301	7370
- Enhance modeling and simulation infrastructure to enable maturation of semi-autonomous UGV's; devise and implement tools to enable rapid maturation of tactical behaviors. In FY04, employed modeling tools to improve the Soldier-machine interface and create a portable laboratory environment that can be utilized to develop a scalable family of interface technology for multiple applications and missions. Resultant technology transferred to TARDEC for application in advanced development programs. In FY05, integrate mechanisms for behavioral adapability into test bed vehicles and evaluate approach through field exercises during which a minimum of two vehicles collaboratively conduct maneuver required for a zone reconnaissance mission while adapting their behavior to reflect environmental changes.	928	809	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Mature perception, intelligent control, and man-machine interface technology required for a single Soldier to manage the operation of multiple unmanned ground vehicles maneuvering with high levels of autonomy through the battlefield. In FY04 implemented fusion of multiple sensor modes for improved terrain reasoning, e.g., providing the ability to detect engineered wire obstacles in complex environments and detect water obstacles. In FY05, mature the perception and control technology required to show baseline tactical behaviors by unmanned ground vehicles adapting to dynamic changes in the environment while maneuvering through rolling, vegetated terrain. This will transition into TARDEC's Armed Robotic Vehicle Program.	5026	4877	0	0
- Mature perception and intelligent control technologies required to meet objective capabilities for the Armed Robotic Vehicle program and transition this technology to advanced development programs being conducted under PE 63005 (Combat Vehicle Advanced Technology) 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 will conduct research in perception and control technologies for autonomous mobility that will permit realistic operational speed for FCS with spirals to Current Force. In FY07, will mature perception and control technology to permit implementation of behaviors to enhance the operational effectiveness of robotic vehicles.	0	0	4868	4913

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Integrate technology on unmanned ground vehicle testbeds 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 TRADOC to initiate early development of the Tactics, Techniques, and Procedures required for successful utilization of unmanned systems in future conflicts. In FY04, incorporated improved perception and control technology to enable baseline cooperative behaviors in rolling, vegetated environments. The underlying research results have been transition to RDECOM advanced development and FCS SDD programs. In FY05, prove baseline adaptive tactical behaviors through field experimentation designed to demonstrate the ability of unmanned systems to autonomously alter behavior in response to changes in the local environment. In FY06, will incorporate advanced perception and control technology and transition to FCS Autonomous Navigation System prototypes for evaluation in relevant environments. In FY07, will evaluate technologies for collaborative operation of networked air & ground unmanned vehicles managed by a single Soldier.	4148	3973	2928	5399
Totals	17675	17023	15097	17682

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H75	ELECTRIC GUN TECHNOLOGY	5114	4946	4802	5050	5278	5368	5414	5454

A. Mission Description and Budget Item Justification: This project funds applied research for the Army Electromagnetic (EM) armaments technology program. To achieve the objectives of the Army Vision, future armored combat vehicles, including the Future Combat Systems (FCS), requires more lethal, yet compact main armament systems capable of defeating protection levels significantly greater than current values. The goal of this project is to evaluate the potential of EM Armaments to field a leap-ahead capability by providing adjustable velocities, including hypervelocity that far exceeds the ability of the conventional cannon. EM armaments potentially can be fully integrated with electric propulsion and electromagnetic armor systems to provide the efficient, highly mobile, and deployable armored force required by the nation. This project focuses on addressing technical barriers associated with an EM armament, in particular with advanced materials for pulsed power and launchers; experimentally validating full-scale hypervelocity utility of novel kinetic energy penetrators against the range of threat armors; and devising and experimentally validating high energy launch packages. In the area of pulse power, it will mature and prove critical materials for compact pulsed power for EM guns. For the launcher, it will establish and mature technologies for efficient, lightweight EM guns and projectile launch packages to enable revolutionary lethality for Future Force platforms. In the area of launch package (projectiles), it will establish technologies for full-scale hypervelocity novel kinetic energy penetrators. This research is conducted at the Army Research Laboratory, Aberdeen Proving Ground, MD. The applied research program receives the output of basic research conducted under H63 by the Institute for Advanced Technology, UT-Austin, and transitions it to the Army environment. In turn, the applied research is moved directly into the ARDEC advanced technology demonstration program where it is 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 the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Pulsed Power - In FY04, devised advanced, high strength composite materials for pulsed alternator rotor and explored rotor thermal management technology. In FY05, prove through laboratory testing the strength of new, thick composite rotor bandings and validate thermal management components. In FY06, prove advanced low density, high strength, low resistivity field coil conductors and efficient switch packaging. In FY07, experimentally validate active cooling of high speed rotor for pulsed power generation.	1953	1877	1898	1920
Launch - In FY04, established processing methodology which was used to fabricate and test an advanced low mass, composite EM launcher; experimentally validated prototype projectile armatures at 2 megajoules (MJ). In FY05, validate integrity of advanced composite EM launchers through actual firing; fire full-up EM projectile at 2 MJ and fire prototype armatures at 8 MJ. In FY06, validate robustness and rail life of composite launcher; and EM launch 8 MJ projectile with monolithic rod. In FY07, EM launch 8 MJ projectile with functioning novel penetrator.	1203	1193	1444	1460
Full-Scale Hypervelocity Lethality - In FY04, established hypervelocity performance of monolithic depleted uranium kinetic energy penetrators and evaluated terminal ballistics of a fixed geometry, novel kinetic energy penetrator (NKEP). In FY05, evaluate flexible geometry NKEP and down-select to most promising hypervelocity penetrator approach. In FY06, mature mechanisms to deploy NKEP in flight. In FY07, validate performance of functional NKEP against realistic targets in full-scale EM gun.	1958	1876	1460	1670
Totals	5114	4946	4802	5050

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H80	BALLISTICS TECHNOLOGY	29573	27840	29264	29436	30010	30778	31044	31269

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 U.S 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 protect Future Combat Systems (FCS) and the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The challenge is to ensure combat overmatch and the survivability of the FCS 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; Kinetic Energy (KE) 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 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); smart projectile 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, 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 the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Optimize advanced lightweight structural, ceramic, and electromagnetic armor technologies for transition to FCS vehicle designers, Current and Future Force Platforms, and Ground Tactical Vehicles. In FY04, transitioned advanced lightweight armor designs to FCS Lead System Integrator (LSI) and TARDEC and demonstrated a more than 15% increase in armor performance with an improved ceramic material; and identified an armor technology that could revolutionize shaped charge defeat. In FY05, optimize armor packaging and transition improved hybrid armor technologies to FCS and current vehicle designers; and validate advanced pulse power componentry necessary to enhance FCS survivability. In FY06, will validate the advanced technology for shaped charge defeat and apply the design tools to tactical vehicles to increase their survivability against small arms and improvised explosive devices. In FY07, will experimentally validate integrated and add-on ballistic protection technologies that make tactical combat vehicles more survivable.	5785	5371	6397	7086
- Mature mine blast, ballistic shock mitigation, and crew protection technologies to enable revolutionary survivability of Current and Future Force Platforms, Ground Tactical Vehicles, and the individual Soldier. In FY04, matured advanced blast and vehicle structure models and experimentally validated first-generation Anti-Tank (AT) mine blast appliqué kit for FCS-class vehicles; also applicable to current platforms. In FY05, validate AT mine blast appliqué kit and crew restraint system for FCS; and show capability of ballistic shock mitigation technologies. In FY06, will advance models and mature first-generation designs for integrated AT mine blast protection structure/crew system. In FY07, will provide design guidance and proven AT mine blast protection structure/crew system to vehicle designers for FCS Spirals and Ground Tactical Vehicles; and will validate technologies to improve flexibility of protection equipment (torso, extremities, neck) for individual Soldier.	2489	1950	3004	3589

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Mature advanced ammunition and lethality technologies. Couple physics-based models describing interior ballistics, launch dynamics, and flight mechanics with system effectiveness models and emerging high G guidance, navigation, and control (GN&C) technologies to enable dynamic retargeting of precision munitions for revolutionary Future Force lethality. In FY04, validated multidisciplinary design (MDD) models for precision gun-fired munitions; incorporated dynamic retargeting into system effectiveness models; and proved high G mortar launch as well as deployment of dynamic retargeting assets. In FY05, transition fully coupled suite of models and validated first generation dynamic retargeting technology to munitions development community. In FY06, will experimentally validate new engineering analysis capability which couples interior, exterior, and projectile structures for analysis of smart munitions; and will validate computational fluid dynamics model of advanced actuator divert for medium caliber munitions. In FY07, will experimentally prove dynamic retargeting technologies (in-flight position update) applicable to FCS and Future Force munitions; and will validate closed loop actuator control system technologies required for divert of medium caliber munitions.	4522	4128	4061	3884
- Mature propulsion and energetics technologies. Evaluate, select, and prove novel/nanostructural insensitive high-energy materials (IHEM) concepts, which exploit managed energy release, and are required for improving the lethality and reducing the vulnerability of FCS/Future Force gun/missile systems and warheads. In FY04, characterized candidate novel insensitive high-energy materials and assessed concepts for exploiting managed energy release for FCS/Future Force gun/missile systems and warheads. In FY05, extend and validate modeling tools used for design of managed energy systems; experimentally assess promising insensitive high-energy materials in notional energy managed configuration; and provide matrix of novel IHEM propellant and explosives candidates for specific Future Force Insensitive Munitions (IM) applications. In FY06, will down-select a weapons system application for validation of novel insensitive energetic material (gun/rocket/ propellant/multi-purpose warhead); and will mature numerical tools for insensitive munitions design. In FY07, will validate selected system using advanced energetic material with tuned energy release (gun/rocket propulsion/ multi-purpose warhead) with increased performance while meeting FCS insensitive munition requirements and will apply emerging numerical tools to novel insensitive munitions.	4623	4505	4132	3734

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- 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 revolutionary survivability of FCS and Future Force platforms. In FY04, proved effectiveness of blast-deflect universal counter-munition warhead and sensor consistent with TARDEC Integrated Survivability Active Defense System requirements. In FY05, prove blast-deflect universal countermeasure design against a variety of KE and CE threats, and transition to TARDEC Integrated Survivability Advanced Technology Demonstration (IS ATD) program. In FY06, will optimize universal counter-munition performance through improved modeling, materials and experimentation. In FY07, will transition optimized universal counter-munition to the IS ATD program.	2000	2000	2000	2000
- 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 FY04, identified penetrator options to reduce energy/mass required to defeat emerging threats and to provide multi-purpose capabilities for revolutionary Future Force lethality. In FY05, mature and integrate emerging materials and novel lethal mechanism technologies & conduct full-scale experimental validation of integrated solution for transition to Future Force munitions developers. In FY06, will integrate lethal mechanisms and prove out broad, multi-functional target defeat capabilities. In FY07, will transition Multi-Threat Objective Projectile Technology to ARDEC and AMRDEC and investigate warhead concepts for tailorable and scaleable lethal effects for Military Operations in Urban Terrain.	3594	3456	3248	3044

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Devise state-of-the-art survivability/lethality/vulnerability (SLV) methodologies to dynamically model the interaction of conventional ballistic threats versus FCS and Future Force System of Systems. In FY04, enhanced methodology and modeling & simulation capabilities addressing active protection systems, fire, and behind-armor debris; devised and proved capabilities to analyze shock in composite materials, munition lethality versus buildings and bunkers, and penetration against thin laminate armors; demonstrated capability for dynamic ballistic experimentation on tail-rotor blades; conducted ballistic experiments on hybrid-electric propulsion systems. In FY05, incorporate models for various damage mechanisms such as fuel fire, blast and shock, and penetration into complex armors, into production SLV codes; model lethality of structural secondary fragments; develop code architecture and capabilities based metrics to assess survivability in a Systems of Systems context. In FY06, will update SLV modeling framework , as well as methodology for emerging technologies. In FY07, will mature newly emerging technologies; will incorporate models for weapons effects in urban environments, including structural response and structural damage mechanisms; experimentally validate models.	6560	6430	6422	6099
Totals	29573	27840	29264	29436

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		21847	7585	2519	2573	2690	2749	2793	2832
552	SMOKE/NOVEL EFFECT MUN	3440	3177	2519	2573	2690	2749	2793	2832
BA1	PROTECTION TECHNOLOGIES (CA)	18407	4408	0	0	0	0	0	0

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. The 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. In FY06 a portion of the funding in project 552 was realigned to PE 0603004 project L97 to mature promising technology for potential transition to System Development and Demonstration (SDD). 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. This work is performed by the Army Research, Development and Engineering Command, Edgewood Chemical Biological Center, Edgewood, MD.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	3476	3633	3661
Current Budget (FY 2006/2007 PB)	7585	2519	2573
Total Adjustments	4109	-1114	-1088
Net of Program/Database Changes			
Congressional Program Reductions	-308		
Congressional Rescissions			
Congressional Increases	4600		
Reprogrammings			
SBIR/STTR Transfer	-183		
Adjustments to Budget Years		-1114	-1088

Change Summary Explanation:
FY06 ($-1114)/FY07 ($-1088) Funds were reprogrammed to budget activity 3 for proper execution.

Three FY05 Congressional adds totaling $4600 were added to this PE.

FY05 Congressional adds with no R-2A:
($959) Biotechnology Education Initiative, Project BA1: This one year Congressional add is to complete development of courses in biotechnology. No additional funding is required to complete this project.

($3451) Rapid Response Deployable Vaporous Hydrogen Peroxide Bio-Chem, Project BA1: This one-year Congressional add is to complete development of vaporous hydrogen peroxide technology for decontamination of both chemical and biological agents. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
552	SMOKE/NOVEL EFFECT MUN	3440	3177	2519	2573	2690	2749	2793	2832

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 researches 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, M&S and vehicle protection technology 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. In FY06 a portion of the funding in this project was realigned to PE 0603004 project L97 to mature promising technology for potential transition to SDD. 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 2004	FY 2005	FY 2006	FY 2007
Advanced IR Obscurants	2300	2350	1331	1322
In FY04, produced test quantities of several candidate materials; evaluated promising candidates in a laboratory environment including one candidate obscurant as a dilute liquid aerosol that exceeds performance goals; evaluated value of emissive obscurants compared to screening obscurants through the use of M&S tools. In FY05, test and assess new IR obscurant screening materials as dry powder aerosol using laboratory evaluation methods; perform simulations to estimate the increase of survivability for the soldier. In FY06, will begin to modify promising high performing materials to maximize dissemination behavior. In FY07, will continue to refine high performing materials, and evaluate performance of these materials in a laboratory environment.				

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Obscurant Enabling Technology for other smoke capabilities (non IR obscurants) In FY04, conducted M&S upgrades and case studies to predict and analyze performance of various obscurant applications; evaluated rapid/variable response vehicle protection concepts and small through medium area (e.g., urban terrain) screening obscuration capabilities. In FY05, perform field experiments on obscuration/dissemination technologies to optimize vehicle protection in selected environments. In FY06, will investigate in a laboratory environment alternative and novel dissemination technologies for existing obscurants to reduce hazards while maintaining yields. In FY07, will continue to investigate new dissemination technologies.	1140	827	1188	1251
Totals	3440	3177	2519	2573

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602623A - JOINT SERVICE SMALL ARMS PROGRAM

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		5506	11273	5703	6024	6277	6348	6403	6450
H21	JT SVC SA PROG (JSSAP)	5506	5521	5703	6024	6277	6348	6403	6450
S50	SMALL ARMS APPLIED RESEARCH (CA)	0	5752	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This Program Element (PE) researches and designs individual and crew-served weapon technologies that will enhance the fighting capabilities and survivability of dismounted battlefield personnel in support of all Services. The technology enhancement efforts of this PE will assure that the next generation of small arms weapons systems will continue to overmatch the evolving threat and address the needs of the Future Combat Systems (FCS) and the Future Force, and, where practical enhance Current Force capabilities. Funded efforts in Project H21 include component technologies for: the Lightweight Machine Gun and Ammunition (LMGA) and Lightweight 5.56mm Ammunition (LWA). The LMGA efforts, complementing both the Objective Individual Combat Weapon (OICW) and the Objective Crew Served Weapon (OCSW), will offer significantly reduced weight over the currently fielded M249 Machine Gun and its associated ammunition. LMGA 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. The LWA effort, which completed in FY04, sought to determine the feasibility of replacing 5.56mm ammunition brass cartridge cases with lighter weight materials such as aluminum or polymers. 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 U.S. 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, USMC PM Infantry Weapons and PEO Special Programs, U.S. Special Operations Command (SOCOM).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	5739	5932	6205
Current Budget (FY 2006/2007 PB)	11273	5703	6024
Total Adjustments	5534	-229	-181
Net of Program/Database Changes			
Congressional program reductions	-166		
Congressional rescissions			
Congressional increases	6000		
Reprogrammings			
SBIR/STTR Transfer	-300		
Adjustments to Budget Years		-229	-181

Change Summary Explanation:

Two FY05 Congressional adds totaling $6000 were added to this PE.

FY05 Congressional Adds with no R-2A:
($3117) Anti-Material Sniper Rifle (AMSR), Project S50: The purpose of this one year Congressional add is to fund research on an anti-material sniper rifle. No additional funds are required to complete this project.

($2637) New Metal Coating Technology for Greaseless Weapons, Project S50: The purpose of this one year Congressional add is to investigate new metal coating technologies for greaseless weapons. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H21	JT SVC SA PROG (JSSAP)	5506	5521	5703	6024	6277	6348	6403	6450

A. Mission Description and Budget Item Justification: This Program Element (PE) researches and designs individual and crew-served weapon technologies that will enhance the fighting capabilities and survivability of dismounted battlefield personnel in support of all the Services. The technology enhancement efforts of this PE will assure that the next generation of small arms weapons systems will continue to overmatch the evolving threat and address the needs of the Future Combat Systems (FCS) and the Future Force, and, where practical enhance Current Force capabilities. The main efforts in Project H21 are component technologies for the Lightweight Machine Gun and Ammunition (LMGA). The LMGA efforts, complementing both the Objective Individual Combat Weapon (OICW) and the Objective Crew Served Weapon (OCSW), will offer significantly reduced weight over the currently fielded M249 Machine Gun and its associated ammunition. LMGA 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 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 U.S. 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, USMC PM Infantry Weapons and PEO Special Programs, U.S. Special Operations Command (SOCOM).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Lightweight Machine Gun and Ammunition (LMGA): In FY04, developed and used 3-D modeling; designed and assessed mechanisms to reduce weight and provide component commonality across a family of weapons; assessed potential of placing traditional weapon function on the Soldier and placing other Soldier system controls on the weapon; for the LWA program evaluated 5.56mm polymer, aluminum, and hybrid cased ammunition concepts to achieve 20% ammunition weight reduction. In FY05, use 3-D models developed previously to continue refining designs for weapon and ammunition components; fabricate limited quantities of the components and evaluate merit on an individual basis for weight and feasibility in a machine gun application. In FY06, will conduct component testing to validate models and populate database with actual values for chamber pressure, muzzle velocity, material strength, and functionality; and update models as necessary. In FY07, will integrate weapon and ammunition component designs, including 3-D models, into weapon system; maximize modularity of components to facilitate future improvements or upgrades; document program processes, models, and simulations to reflect current design status.	5506	5521	5703	6024
Totals	5506	5521	5703	6024

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602624A - Weapons and Munitions Technology

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		76108	102442	37824	36764	36850	36308	34264	35648
H18	ARTY & CBT SPT TECH	14449	20036	13571	14764	10798	11018	10591	11743
H19	CLOSE COMBAT WEAPONRY	6564	6480	7054	8611	12197	11397	11494	11579
H1A	WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE	28293	50474	0	0	0	0	0	0
H28	MUNITIONS TECHNOLOGY	26802	25452	17199	13389	13855	13893	12179	12326

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 with a focus on meeting requirements of the Future Combat Systems (FCS). Efforts in this PE result in increased system lethality and survivability with the potential for lower weight, reduced size and improved affordability. Projects H18, H19, and H28 contain efforts that support the FCS 120mm Line-Of-Sight (LOS)/Beyond-Line-Of-Sight (BLOS) System Advanced Technology Demonstration (ATD). This ATD, which completes in FY05, matures and evaluates armament system components and the associated LOS/BLOS ammunition in direct support of the FCS Mounted Combat System (MCS). Although the ATD is focused on developing a 120mm solution, the technologies pursued are applicable to either a 120mm or 105mm lightweight gun system, whichever becomes the final MCS design. The ATD will mature advanced materials, advanced recoil techniques, and Electrothermal Ignition (ETI) to overcome the challenges of creating a smaller, lighter armament system with lethality equaling or exceeding that of current systems. The Mid-Range Munition (MRM) is being developed to provide the BLOS capability for MCS. Projects H18, H19, and H28 also support the MCS Ammunition System Technologies (MAST) effort focused on developing lighter weight armament components to enhance both the performance and ammunition packaging efficiency of the FCS LOS/BLOS armament system for FCS spiral insertion or MCS upgrade. Additionally, Projects H18, H19 and H28 support Common Smart Submunition, which will develop and demonstrate component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems. Other major efforts in Project H18 include an Insensitive Munition (IM) Technologies Initiative, focused on reducing unplanned/accidental detonation of munitions; and Enabling Fuze Components for Advanced Munitions, which will develop technologies that reduce munition size and add tailorable effects. Other efforts in H19 include: Agile Target Effects System (ATES), which will employ a non-lethal, Directed Energy (DE) capability to suppress a variety of threats launched close to a platform.; and Common Modular Power Sources, which is developing on-board munition power systems with increased energy/power densities to extend the range and increase lethality of future munitions. Project H1A funds Congressional special interest items. Project H28 focuses on the design and development of advanced warheads (both shaped charge and Explosively Formed Penetrators (EFP)); modeling and analytic codes for thermal analysis; novel energetics/explosives; and high impetus, low flame temperature propellants to reduce wear on gun tubes. 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).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	44666	43385	41160
Current Budget (FY 2006/2007 PB)	102442	37824	36764
Total Adjustments	57776	-5561	-4396
Net of Program/Database Changes			
Congressional Program Reductions	-1702		
Congressional Rescissions			
Congressional Increases	61950		
Reprogrammings			
SBIR/STTR Transfer	-2472		
Adjustments to Budget Years		-5561	-4396

Change Summary Explanation:
FY06 - Funds realigned ($5561K) to higher priority requirements.
FY07 - Funds realigned ($4396K) to higher priority requirements.

Thirty FY05 Congressional adds totaling $61950 were added to this PE.

FY05 Congressional Adds with no R-2A:
Active Coatings Technology, Project H1A ($1918)
Active Coating Technology, Project H1A ($2023)
Advanced Integrated Digital Camera Rifle Scope (ADCRS), Project H1A ($959)
Advanced Technology Lightweight Armament System – Rarefaction Wave Gun, Project H1A ($959)
Amorphous Metal Manufacturing Technology for Military Applications, Project H1A ($959)
Applied Research Integration, Project H1A ($1727)
Applied Research Program for Advanced Materials and Processes for Armament Structures Program, Project H1A ($3836)
Armament Systems Engineering and Integration Initiative (ASEI2), Project H1A

($4028)
Armaments Systems Information Assurance, Project H1A ($2014)
Army Welding Deployment Initiative, Project H1A ($959)
Deep Digger, Project H1A ($959)
Dynamic Pulse Detonation, Project H1A ($959)
Electroconversion of Energetic Materials, Project H1A ($2397)
Green Armaments Technology Initiative, Project H1A ($3356)
Hazardous Materials Management and Technology Development, Project H1A ($959)
Integrated Emergency Operations Capabilities (IEOC), Project H1A ($1630)
Less than Lethal and Layered Protection Systems, Project H1A ($1918)
Micro-Laminate Ceramic Armor, Project H1A ($1726)
Perimeter Defense Technologies, Project H1A ($2110)
Polymer Cased Ammunition – 5.56mm, Project H1A ($959)
RangeSafe Technology Demonstration Initiative, Project H1A ($2877)
Research Authority Active Coatings Technology (ACT) Program, Project H1A ($959)
Scram-Jet Powered Munitions for Future Combat Systems, Project H1A ($959)
Seamless Data to Display, Project H1A ($3356)
Strategic Materials/Strategic Manufacturing Initiative (SM2i), Project H1A ($2158)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H18	ARTY & CBT SPT TECH	14449	20036	13571	14764	10798	11018	10591	11743

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 FCS, 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 for FCS. Improved smart munitions will be pursued to enhance FCS Non Line of Sight (NLOS) capabilities and area denial capabilities that 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, reducing logistic burden. Specific major efforts include: FCS 120mm LOS/BLOS System ATD, which designs and tests ammunition handling components, muzzle brakes and turret drives for the FCS MCS; MCS Ammunition System Technologies (MAST), which will mature component technologies to enhance capabilities of the FCS MCS munition suite; and Common Smart Submunition (CSS), which will develop component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems. Beginning in FY05, the project funds an Insensitive Munition (IM) Technology Initiative, which focuses on developing and applying technologies that will reduce unplanned, accidental and/or sympathetic detonation of munitions in order to achieve mandated IM compliance regulations. For gun propulsion systems the focus is on developing barrier and venting technologies for existing and future gun propulsion systems and high energy, IM gun propellants at the sub-scale level for emerging gun programs. For warheads this effort will develop venting and IM liner technologies for existing and future explosive projectiles. In addition, the effort will develop predictive modeling capabilities for IM technologies. Efforts also starting in FY05 are: Enabling Fuze Components for Advanced Munitions, which will research and evaluate technologies that reduce munition size and add tailorable effects for advanced munitions; and Future Force (FF) Gun and Munition Technology, which will develop leap-ahead concepts for FF armaments, munitions and energetics and exploit novel nano-structured metal/ceramic materials. Beginning in FY07, this project will begin researching 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 2004	FY 2005	FY 2006	FY 2007
FCS 120mm LOS/BLOS System ATD: In FY04, completed subsystem tests of ammunition handling components to verify compatibility with combustible case ammunition; completed firing tests at Army Research Laboratory using 20mm surrogate ammunition to validate the design and models for advanced muzzle brake with blast deflector to protect vehicle structure and sensors from firing overpressure; conducted lab tests of prototype gun turret electric drives.	6026	0	0	0
MAST: In FY04, completed initial designs and fabricated improved proximity sensor for LOS Multi-Purpose (LOS-MP) projectile.	1889	0	0	0
Networked Sensors for the Future Force ATD: In FY04, designed low cost, distributed and networked unattended ground sensors.	1341	0	0	0
Lightweight Dismounted Mortar Weapon: In FY04, conducted analysis of material options to assess viable candidates for thermal, dynamic and economical feasibility; fabricated mock-ups for mechanical assessment.	1000	0	0	0
CSS: In FY04, began system design, risk assessment, and trade studies to baseline metrics for hard and soft carrier applications, and determined operational performance of sensor and lethal mechanism design requirements. In FY05, design and build hardened components and test critical subsystems in an air gun; build breadboard sensor and conduct electronics evaluation prior to full function submunition integration; initiate CSS integration model development. In FY06, will miniaturize sensor, electronics and deployment system components into a CSS smaller brassboard suitable for UAV, missile, and projectile applications. In FY07, will design and test a CSS brassboard hardened for gun launch, with advanced explosively formed penetrator warhead, and advanced sensors and electronics in preparation for cable drop test against target array scheduled for early in FY08.	712	6203	5651	2936

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
IM Technologies Initiatives: In FY04, begin developing tools for predictive technology for insensitive munitions design. In FY05, investigate barrier materials and on-set threshold velocity; select two propellant families and initiate study; develop computer model to analyze venting designs and perform baseline laboratory hardware experiments; model and simulate bullet impact and sympathetic detonation threshold on a selected explosive. In FY06, will select barrier materials for pallet and/or container concepts and test ability to break up and slow down fragment threat; design vent for a selected munition; fabricate propellants and evaluate through sub-scale testing; apply venting design to laboratory hardware and evaluate effectiveness in a lab; perform optimization of detonation threshold modeling for bullet impact and sympathetic detonation. In FY07, will fabricate and test selected pallet and vented container with munition; downselect propellants and conduct sub-scale testing; apply thermal modeling and venting to full scale prototype design and experimental verification; use M&S tools to design an effective barrier against sympathetic detonation.	300	1850	2150	3100
Future Intelligent Munition: In FY04, conducted system/subsystem simulations and determine best technical approach; conducted analysis to determine the on-board detector requirements of the munition in the context of the sensor technology proposed for the Intelligent Munition System and FCS.	712	0	0	0
Enabling Fuze Components for Advanced Munitions: In FY05, begin the design and modeling of large caliber Micro-Electro Mechanical Systems (MEMS) Safe and Arm (S&A) components, multipoint Electronic Safe & Arm Device (ESAD) components and proximity and safety sensors. In FY06, will conduct laboratory evaluation of MEMS S&A components, ESADs and safety sensors designs. In FY07, will integrate MEMS S&As and ESADs with sensors and continue laboratory evaluation verify models.	0	3050	3490	3400
Future Force Gun and Munition Technology: In FY05, conduct investigations of lighter weight armament systems and extended range more lethal munitions; model induction plasma process for producing nano-aluminum. In FY06, will develop most promising technology solutions for system application; verify ability to achieve 1 kg/hr deposition rate for nano-aluminum particles. In FY07, will refine and demonstrate process design concept for nano-ceramic materials.	0	3030	1419	416
Future Force Breaching in Military Operations in Urban Terrain. In FY06 will mature the breaching system to reduce the minimum safe distance from 300 m. to 100 m. which improves safety and reduces the effort to complete a wall breaching mission during urban operation. In FY07, will conduct hand emplaced demonstration against spectrum of wall targets.	0	0	861	953

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
High Power Microwave (HPM) - Non Lethal: In FY07 will develop a non-explosive HPM projectile capable of being fired from a NLOS platform to provide an area of mission kill effect against electronic materiel that ranges from persistent upset to permanent damage; will initiate and complete tradestudy to establish total system design parameters; initiate payload development with HPM source; design antennae consistent with system parameters.	0	0	0	3959
Acoustic Counter Battery System: This one year Congressional add matured and integrated a passive acoustic sensing system designed to detect and locate hostile artillery and mortar fires and provided targeting information to fire direction centers. No additional funding is required to complete this effort	2469	0	0	0
Acoustic Counter Battery System: This one year Congressional Add adapted the demonstrated capability of the permanently fixed site concept to a portable, scalable and reconfigurable package. No additional funding is required to complete this effort.	0	2516	0	0
Army Center of Excellence in Acoustics: In FY05, this Congressional add conducts innovative research and development in acoustic technology with academic & commercial partners to support a wide spectrum of army requirements ranging from rapid fielding iniatiatives to accelerating technology insertion into major programs; e.g., FCS and Intelligent Munitions System.	0	3387	0	0
Totals	14449	20036	13571	14764

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H19	CLOSE COMBAT WEAPONRY	6564	6480	7054	8611	12197	11397	11494	11579

A. Mission Description and Budget Item Justification: This project focuses on applied research and technology for maneuver and fire support cannon armament systems in support of 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 with more accurate delivery, significantly reduced logistics footprint and reduced life cycle costs for ground combat platforms. This project provides opportunities for longer range, more accurate and more lethal cannon systems for armored vehicles, to include enabling technologies to support FCS. Both hardware and analytical tools will be refined and used to assess performance, identify problem areas and formulate solutions. Principal efforts support the FCS 120mm LOS/BLOS System ATD, which completes in FY05 and MCS Ammunition System Technologies (MAST) by the design and development of a FCS ammunition suite for rapid extended range defeat of high-value targets out to 8km+; modeling and simulation of advanced armament systems; cannon design technologies including recoil mitigation techniques for use of large caliber cannons on lightweight vehicles; novel chamber configuration; and advanced barrel coating technology to provide extended barrel life for tank, artillery and FCS cannon systems. This project will mature advanced multi-mode fuzing technologies, extended range munitions and alternative mechanisms to defeat advanced armor systems. The Agile Target Effects System (ATES) effort evaluates a breadboard/brassboard that delivers a synergistic combination of Directed Energy (DE) technologies to suppress/defeat close in threats. Rheostatic Pulsed Energy Weapons System (RPEWS) will refine the design of a DE weapon system exploiting advances in pulsed power supplies. The Urban Warfighter Technology effort will design and develop technologies to address the soldiers needs for operations in urban terrain. Common Modular Power Sources for Munitions 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. In FY07 Non-Lethal Payloads for Personnel Suppression and Vehicle Area Denial will begin to address the technical challenges associated with surpressing or denying access to designated areas. 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 2004	FY 2005	FY 2006	FY 2007
FCS 120mm LOS/BLOS System ATD: In FY04, completed composite cell design and vibration testing for hull ammunition storage; evaluated ability of advanced Kinetic Energy (KE) munition to defeat future heavy armor target.	2711	0	0	0
MAST: In FY04, completed initial designs and initiated fabrication of LOS-Multi-Purpose (LOS-MP) projectile.	500	0	0	0
Agile Target Effects System (ATES): In FY04, integrated selected DE sources into brassboard; determined effectiveness of agile source against representative target(s).	3353	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Rheostatic Pulsed Energy Weapons System - In FY05, conduct target effects/material interaction tests using selected agile DE source technology. In FY06, will continue target effects/material interaction tests, and initiate a baseline integrated system design. In FY07, will finalize the integrated system design based on results of the target effects/material tests; begin acquisition of the long lead hardware/components for the objective system; and design High-Powered Microwave countermeasures.	0	1441	2644	4571
Urban Warfighter Technology: Investigate technologies for mounted and dismounted warfighters in an urban situation including cabability to deliver stand-off lethality and defeat of counter-lethality.	0	3156	0	0
Common Modular Power Source for Munitions: In FY05, initiate design and testing of advanced energy systems based on thermal and liquid reserve batteries with lower volumes, new electrolytes, and higher power densities; and perform modeling of advanced thermal battery technology. In FY06, will conduct laboratory evaluation and initial testing of preliminary designs on new thermal and liquid reserve batteries.	0	1313	2000	0
Common Smart Submunition Warhead: In FY05, assemble component warhead technologies (i.e. Novel Energetics, Multiple Effects, and Gen II EFP) for a breadboard warhead design.	0	570	0	0
Non-Lethal Payloads for Personnel Suppression and Vehicle Area Denial: In FY06, will conduct analysis to determine appropriate material for nano-particle payload to achieve desired effects; will conduct packaging studies; will conduct dissemination test and initial health and environmental assessment. In FY07, will verify effectiveness of area denial round to disable vehicle target; and optimize nanoparticle material and conduct performance evaluations in relevant environments.	0	0	2410	4040
Totals	6564	6480	7054	8611

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H28	MUNITIONS TECHNOLOGY	26802	25452	17199	13389	13855	13893	12179	12326

A. Mission Description and Budget Item Justification: This project advances the state of the art for enabling technologies supporting the FCS and 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. The project funds maturation of 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 initiation techniques and advanced material technologies are being applied to produce smaller, lighter, more effective, multi-role warheads with advanced warhead liners to defeat existing and projected targets more efficiently. Aerostable EFP designs will be investigated to enable target defeat from greater standoff range to counter adversaries' Active Protection Systems. High-energy, high-density explosives are being matured to increase lethality and optimize design performance. New improved energetic materials provide numerous transition opportunities for weapon system upgrades and FCS. High-impetus propellant formulations, optimized for Electrothermal Chemical Ignition (ETI), offer increased muzzle kinetic energy, precision ignition and repeatability. Efforts under this project support the FCS 120mm LOS/BLOS System ATD completing in FY05, Medium Range Munition (MRM) and Mounted Combat System (MCS) Armament System Technology (MAST), all of which contribute to providing a lightweight armament and ammunition system for FCS MCS. MAST will increase MRM's range and improve performance against various (multiple) targets. Other major efforts in this project include Novel Energetic Materials for the Future Force, which will develop advanced energetic materials with the ability to control energy release for precision munition and counter-munition applications; Hardened Combined Effects Penetrator Warhead Technology, which will provide overmatch lethality using a single warhead capable of defeating armor, bunkers, personnel and Unmanned Air Vehicles. Multiple-EFP Warheads Technology focuses on analysis and maturation of EFP munitions supporting the Army's research and development of vehicle-mounted Active Protection Systems (APSs) and other applications. Future Force (FF) Guns, Munitions and Armor designs and evaluates technologies for a lightweight, single stage wall breaching system that can create Soldier size entry hole in a spectrum of urban walls in 1/3 of the time currently required; develops extended range munitions for 120mm mortar application; and develops nanomaterials for lightweight composite armor applications. 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 in support of the Integrated Survivability ATD managed by the Tank Automotive Research, Development and Engineering Center (TARDEC) under Program Element (PE) 0603005A (Combat Vehicle and Advanced Automotive Technology).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
FCS 120mm LOS/BLOS System ATD: In FY04, completed fabrication and integration onto the lightweight 120mm cannon of a complete ETI system, including a compact pulsed power supply; completed testing to verify predicted performance of improved shaped charge warhead in a configuration suited for the MRM round.	9000	0	0	0
MAST: In FY04, completed initial propulsion and warhead designs; and fabricated and conducted initial warhead laboratory tests of Line-Of-Sight Multi-Purpose (LOS-MP) munition. In FY05, complete warhead testing and evaluation of LOS-MP for airburst capability, concrete wall penetration and anti-armor performance; optimize Electronic Safe & Arm (ESA) subsystem of multi-effects warhead; complete analysis of LOS-MP performance for selection of final design configuration; and complete design of advanced propulsion providing precision ignition and hot performance across entire temperature range. In FY06, will complete initial design and integration of Counter APS and Dynamic Retargeting Capabilities for Enhanced MRM and conduct full-up integrated system test and evaluation.	1795	9342	3431	0
Novel Energetic Materials for the Future Force: In FY04, characterized candidate energetic materials and assessed energetic system concepts exploiting managed energy release for advanced gun propellant and explosive formulations. In FY05, define matrix of energetic materials technologies for advanced gun propulsion and advanced explosives for warhead applications; experimentally assess the potential benefits of energy managed materials (high tailorability) by generating the appropriate comparative experimental data. In FY06, select a system application for demonstration of novel energetic material (gun propulsion/rocket/multi-purpose warhead); verify the predicted performance and multi-purpose benefit based on additional laboratory experiments and simulations as well as subscale and/or test scaled units; downselect the enabling energetic materials. In FY07, bound the performance characteristics, e.g., pressure & temperature characteristics of the gun propellant and new energetic material for warheads through testing and modeling of selected gun propulsion/multi-purpose warhead; will conduct analysis to determine performance/surivability characteristics compared tocurrent systems with conventional energetics.	3000	3946	6100	6800

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Hardened Combined Effects Penetrator Warhead Technology: In FY04, conducted hardened shaped charge warhead modeling/design evaluation and initial baseline hardware experimentation including armor penetration, urban targets and baseline fragmentation. In FY05, determine the critical impact parameters associated with penetration of targets such as masonry and reinforced concrete walls; mature hardening techniques and hardened designs of the penetrator; and evaluate candidate multi-purpose energetic materials including energetics structural integrity. In FY06, will incorporate enhanced blast explosives and advanced fragmentation designs into hardened shaped charge warheads and conduct in-process testing. In FY07, will evaluate test results and will refine and optimize designs accordingly; and repeat in-process testing to confirm performance of optimized warhead against selected targets.	1000	4883	5734	4250
Multiple EFP Warhead Technology: In FY04, integrated APS EFP warhead into counter-munition; optimized warhead design with system fuzing; refined and evaluated a revolutionary single liner EFP warhead concept for FCS smart munitions; designed and evaluated a 1.5 to 2 caliber long EFP. In FY05, conduct dynamic testing of optimized APS warhead integrated into counter-munition.	4452	2136	0	0
Common Smart Submunition: In FY05, analyze and test breadboard warhead design to validate significant increase in armor penetration over existing designs. In FY06, will improve EFP warhead aerostability and hit accuracy.	0	1443	671	0
Common/Modular Power Source for Munitions: In FY05, conduct laboratory evaluation and initial testing of preliminary designs; initiate producibility studies. In FY06, will evaluate performance of hybrid system.	0	500	310	0
Future Force Guns, Munitions and Armor: In FY05, conduct computer modeling and simulations of candidate wall breaching designs for MOUT; complete preliminary prototype hardware design. In FY06 will design the prototype breaching system, that is 20% lighter system than current approaches, to create solder size entry holes in reinforced concrete walls in 2 minutes (currently 6 minutes is required to complete mission). In FY07, will mature the breaching system to create entry holes in double reinforced concrete wall with a single operation.; will conduct investigations for improved lethality at extended ranges for precision mortars; will initate lab scale processing method for Boron carbide nano-ceramic materials for lightweight composite/armor; and will conduct an analysis to determine the optimal approach for a Counter Lethality System vs. rockets, artillery and mortars; including trades for tracking systems, fire control solutions and munitions for engaging the incoming threat; will create models for the subsystems.	0	122	953	2339
Generation 2 Warhead Development, Explosively Formed Penetrator (EFP): In FY04, this Congressional add conducted tests to determine aerostability of an EFP out to 50 meters against an armor target. In FY05, this Congressional add demonstrates the ability to defeat a surrogate complex armor target and improved hit accuracies at 50 m. No additional funding is required to complete this effort.	2025	1059	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Liquidmetal Alloy-Tungsten Alloy Penetrator: In FY04, developed a higher density amorphous alloy with the intent of increasing the end-item bulk density of the completed/infiltrated penetrator core intermetallic compounds, and degree of infiltration that ultimately effected the overall quality of the end item.	1095	0	0	0
Liquidmetal Alloy-Tungsten Alloy Penetrator: This one year Congressional add optimizes the metallurgical and physical geometry of the tungsten preform, as well as its internal open porosity to influence terminal ballistic performance. No additional funding is required to complete this effort.	0	2021	0	0
Tandem EFP Warhead Systems: This one year Congressional add completed a study on optimizing function and interface of EFP warheads in the Tandem EFP Warhead System. No additional funding is required to complete this effort.	964	0	0	0
Modular Artillery Charge System (MACS) High Zone Development: This one year Congressional add accepted four lots of hybrid propellant for ballistics performance evaluation. No additional funding is required to complete this effort.	2025	0	0	0
Single Crystal Tungsten Alloy Penetrators: This one year Congressional add investigated performance of subscale single crystal tungsten penetrator rods fabricated by chemical vapor deposition process. No additional funding is required to complete this effort.	1446	0	0	0
Totals	26802	25452	17199	13389

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602705A - ELECTRONICS AND ELECTRONIC DEVICES

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		76609	102768	39554	41536	43629	46862	47320	47728
EM4	ELECTRIC COMPONENT TECHNOLOGIES (CA)	7013	23008	0	0	0	0	0	0
EM6	HEATING AND COOLING TECHNOLOGIES (CA)	4383	3451	0	0	0	0	0	0
EM7	POWER AND ENERGY COMPONENT TECHNOLOGIES (CA)	29160	36266	0	0	0	0	0	0
H11	BATTERY/IND POWER TECH	6913	11877	12167	12669	12108	12076	12180	12269
H17	FLEXIBLE DISPLAY CENTER	0	0	4965	5084	5047	5046	5094	5105
H94	ELEC & ELECTRONIC DEV	29140	28166	22422	23783	26474	29740	30046	30354

A. Mission Description and Budget Item Justification: This program element provides 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 to provide enhanced communications and target acquisition for Future Combat Systems (FCS) and Future Force Warrior applications. Project H11 will provide future Soldiers and other Future Force platform applications low weight and volume, safe, reliable and cost effective power sources, reduced system power requirements, increased mission duration and reduced cost and logistics burden. Project H94 consists of 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, batteries, electromechanical systems (engine generator sets) and fuel cells. Project H17 supports research at the new Flexible Display Center to enhance battlefield situational awareness, increased vehicle mobility, survivability and lethatlity, 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. Work in this PE is related to and fully coordinated with efforts in PE 0602120 (Sensors & Electronic Survivability), PE 0602782 (Command, Control, Communications Technology), PE 0602709 (Night Vision Technology), PE 0602783 (Computer and Software Technology), PE 0603008 (Command, Control, Communications Advanced Technology), and PE 0603772 (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 th

e Army Research Laboratory and the Army Communications and Electronics Research Development and Engineering Center, Fort Monmouth NJ.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	41236	45919	43609
Current Budget (FY 2006/2007 PB)	102768	39554	41536
Total Adjustments	61532	-6365	-2073
Net of Program/Database Changes			
Congressional Program Reductions	-1501		
Congressional Rescissions			
Congressional Increases	65430		
Reprogrammings			
SBIR/STTR Transfer	-2397		
Adjustments to Budget Years		-6365	-2073

Change Summary Explanation:
FY06 - Funds realigned ($6365K) to higher priority requirements.

Thirty Four FY05 Congressional Adds totaling $65430 were added to this PE.

FY05 Congressional adds with no R-2A:
Advanced High-Energy Rechargeable Lithium Air Battery, Project EM7 ($1918)
Advanced Power Component Technologies, Project EM7 ($959)
Advanced Simplified Hybrid Fuel Cell/LiON Battery Program for the Future Force Warrior, Project EM7 ($959)
Battery Returns in Error Advanced Vehicle Battery Management Program (Phase II), Project EM7 ($959)
CFx Electrochemical Systems for Safe Soldier Power, Project EM7 ($959)
Conformal Lithium Ion Polymer Belt Battery, Project EM7

($959)
Cylindrical Zinc Air Battery for Future Soldier Communications Systems, Project EM7 ($959)
Direct Diode Electro-Optical Source, Project EM4 ($5276)
Dry Polymer Electrolyte Development for Safe Soldier Power, Project EM7 ($3098)
E-Beam Reticle and Lithography Inspection, Project EM4 ($6137)
Flexible Display Initiative: High Performance Displays for Military Applications, Project EM4 ($5370)
Flexible Polymer Multilaminate Packaging, Project EM7 ($1918)
High Power Solid State Lasers, Project EM4 ($959)
Integrated Methanol Fuel Cell/Reformer, Project EM7 ($959)
JP-8 Soldier Fuel Cell, Project EM7 ($959)
Liquid Silicone Lithium Rechargeable Battery, Project EM7 ($1439)
Lithium Metal Air Battery, Project EM7 ($719)
Low Cost Power Generation Platforms and Electric Power Control Hybrid Vehicles, Project EM7 ($1630)
Metal Oxide Cathode – 1.5v Alkaline, Project EM7 ($1200)
Nanofluidic Electronic Sensor Technologies for Defense Applications, Project EM4 ($1438)
Novel Zinc Air Power Sources for Military Applications, Project EM7 ($959)
ONAMI Miniature Tactical Energy Systems Development, Project EM7 ($2397)
PEM Fuel Cell Quiet Tactical Generators, Project EM4 ($959)
Portable Reforming on the Battlefield, Project EM7 ($959)
Rapid Recharge, Lithium-ion Battery Pack, Project EM7 ($2493)
Rechargeable Cylindrical Cell System-Lithium Ion/Nickel Metal Hydride, Project EM7 ($1438)
Ring Extruder, Project EM4 ($2397)
Software Defined Radio Communications Interoperability Initiative, Project EM7
($1007) Soldier Fuel Cell System, Project EM7 ($1438)
Soldier Portable Fuel Cell Power, Project EM7 ($2350)
State of Charge Battery Life Indicator, Project EM7 ($1534)
Transcritical CO2 Environmental Control Unit, Project EM6 ($3452)
Universal Radio Frequency Identification (RFID) Monitoring Device, Project EM7 ($959)
Weapons of Mass Destruction Marking Set, Project EM7 ($1630)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H11	BATTERY/IND POWER TECH	6913	11877	12167	12669	12108	12076	12180	12269

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 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 2004	FY 2005	FY 2006	FY 2007
- 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 FY04, demonstrated a safe, 2 pound, 170 Wh/kg lithium-ion polymer rechargeable battery; and demonstrated power management approaches for soldier systems. In FY05, investigate system level stand-alone smart charger technology with 2-hour recharge capability for soldier batteries; investigate power management techniques to reduce operating system power draw for soldier systems by 50%. In FY06, will develop and evaluate logistic fueled small Stirling engine generator components for silent manportable (<10kg) power <500 W; will demonstrate a hybrid battery/liquid fuel power source. In FY07, will investigate system-level smart chargers integrated with a quiet power source for stand-alone charging.	4843	7613	7817	8168
- 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, and tactical power management systems. In FY04, evaluated 10-kilowatt proof-of-concept system components leading to quiet, smaller, and fuel-efficient generator. In FY05, develop components for a 2 kW fuel processing system operating on low-sulfur fuel (<50 parts per million sulfur). In FY06, will investigate fuel cell reformer components for 1-2 kilowatt system for scout vehicle silent watch; will investigate and mature logistic fueled Stirling engine generator components for silent mobile (for vehicle/trailer platforms) power >1kW; will evaluate integrated 2 kW fuel processing system operating on low-sulfur fuel. In FY07, will investigate system-level heat-driven cooling components for application to tactical co-generation systems; will evaluate components for 2 kW fuel processing system operating on high sulfur fuel (>300 parts per million sulfur).	2070	4264	4350	4501
Totals	6913	11877	12167	12669

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H17	FLEXIBLE DISPLAY CENTER	0	0	4965	5084	5047	5046	5094	5105

A. Mission Description and Budget Item Justification: This project funds the new Flexible Display Center at Arizona State University. The objective of this project is to conduct applied research in advanced and novel electronic displays. 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: 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 2004	FY 2005	FY 2006	FY 2007
- In FY04 and FY05, this effort was funded in this PE under Project H94. The Army established a Flexible Display Center at Arizona State University to develop flexible display technology demonstrations for future vehicle and future Soldier applications. In FY06, will investigate 4" diagonal Active Matrix reflective displays from pilot line. In FY07, will investigate 4" diagonal Active Matrix emissive displays from pilot line. Management and applied research will be conducted by ARL in collaboration with Natick Soldier Center, the center, industry, and other university partners.	0	0	4965	5084
Totals	0	0	4965	5084

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H94	ELEC & ELECTRONIC DEV	29140	28166	22422	23783	26474	29740	30046	30354

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, 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 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 UV/IR vertical emitters, will be a key enabler for more affordable 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. In FY2004 and 2005, this project also funds the new Flexible Display Center at Arizona State University. In FY06, the Flexible Display effort was restructured to Project H17 for increased visibility and management oversight. 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 2004	FY 2005	FY 2006	FY 2007
- Mature high performance antennas and RF front-end architectures to support multifunction radar systems; and design and evaluate electronically scanning antennas for multifunction RF applications. In FY04, assessed a very high efficiency Ka-band amplifier and control devices; and designed, fabricated, and evaluated multilayer Ka-band apertures for narrow elevation beam. In FY05, prototype small linear Ka antenna arrays, using ferroelectric and micro electro mechanical system (MEMS) phase shifter technology to assess feasibility of each concept in terms of loss and beam positioning speed. In FY06, will investigate approaches for integrating antennas in composite armor. In FY07, will design, fabricate and evaluate performance of armor integrated antennas.	3744	2984	956	990
- 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 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 FY04, established reliability evaluation of 1st generation Aluminum Nitride (AlN) MEMS resonators; designed 2nd generation resonators for high frequency filter applications; and reduced in-band spurs in opto-electronic oscillator (OEO) with performance suitable for moving target indicator (MTI) sensors. In FY05, examine the performance of E-Beam lithography in patterning nanoscale RF structures for Future Force and future Soldier communications; and design and evaluate phase-locked cavity based stabilized local oscillator (STALO) with RF front ends. In FY06, will explore nano science and technology for smart nano materials; and will design and evaluate Ka-band low phase noise, temperature insensitive ceramic dialectic resonant oscillator (DRO) oscillator and compare with OEO. In FY07, will design, simulate, and fabricate discrete smart nano devices; and will evaluate stabilized oscillator dual mode crystals with low hysteresis temperature effects.	2403	2914	2870	2966

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Research, design, and investigate new component materials, structures, devices, and EM 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 vehicle (UAV), Electronic Warfare (EW), radar, and soldier systems. In FY04, devised VE tubes for millimeter power modules (MMPMs); and assessed the performance of microwave/millimeter wave wide bandgap devices and circuits. In FY05, integrate VE tube with semiconductor amplifier and power supply in MMPMs and characterize; evaluate new components to support design of next generation mmW active apertures; and complete transmit/receive (T/R) module incorporating wide bandgap MMICs for synthetic aperture radar/moving target indicator (SAR/MTI) radar to support tactical unmanned aerial vehicles. In FY06, will fabricate and evaluate high power (60W) Q-band MMPM amplifier; and will investigate reliability of gallium nitride (GaN) devices under high temperature, fabricate 2nd generation devices, and implement packaging concepts with thermal modeling. In FY07, will characterize, analyze, and evaluate high power (80W) Ka-band MMPM; and will design and characterize GaN transmit/receive (T/R) and power amplifier modules.	1972	3087	2909	3004

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Investigate eye-safe scannerless 3-D imaging laser radar (ladar) and multi-color passive infrared (IR) imaging focal plane arrays (FPAs) and cameras 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 FY04, integrated eye-safe components, laser, and detector operating at 1.5 um into ladar breadboard; performed airborne evaluation of two-color passive IR camera for mine detection and collected passive IR signatures of targets and backgrounds to support the development of advanced dual-band passive IR sensors; and fabricated and characterized the nonlinear properties of phase change materials such as fast switches and sacrificial materials with application to passive protection of EO vision systems. In FY05, show an improved version of ladar breadboard, field test, and collect data to show functionality for target acquisition; using the newly constructed tandem test bed, characterize promising nonlinear optical materials in militarily relevant focusing configurations. In FY06, analyze passive IR target and background signatures and recommend design criteria to CERDEC for advanced IR dual-band passive sensors; ealuate and select a nonlinear limiting material with large bandwidth and high optical density. In FY07, design and evaluate obscured target detection through 3-D ladar imagery in simulated UAV and ground-to-ground scenarios and transition to CERDEC Mission Equipment Package for Class II UAV program; address issues associated with encapsulating the selected nonlinear material in a solid host, leading to development of a robust limiting device, which provides technologies to protect against damage at all laser wavelengths across the operating spectrum of the Future Force electro-optic vision systems.	3080	2709	3025	3041

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Investigate molecular beam epitaxy (MBE) growth techniques for the growth of mercury cadmium telluride (HgCdTe) on Silicon substrates for both the mid and long wave IR spectral region to significantly decrease the cost and to allow the development of large area arrays. Also design and fabricate arrays for higher operating temperature. In FY04, midwave arrays were fabricated with equal performance compared to arrays grown on the standard cadmium telluride (CdTe) substrates. Also first Long Wave IR (LWIR) arrays were grown with promising results. In FY05, achieve growth of LWIR arrays with less than 2% defective pixels. In FY06, will fabricate large area arrays-up to 1000X1000 pixels for both MWIR and LWIR with a goal of less than 1% defective pixels; and will fabricate arrays with new detector design for higher operating temperature. In FY07, will continue the growth of high temperature arrays with the goal of achieving operating temperatures of 180 Kelvin for MWIR and 120 Kelvin for LWIR.	1295	2385	2048	2585

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Investigate a broad base of extremely quick, accurate, and novel photonic architectures to enable detection of hazardous substances to enhance soldier survivability. Investigate novel new vertically emitting ultraviolet (UV) emitters offering packaging and cost advantages for environmental sensing and non-line-of-sight UV communications. Investigate new vertically emitting mid-wave Infrared (IR) and near-IR LEDs and lasers for IR scene simulation, opto-electronic (OE) sensors and OE flow/processing of sensor data. In FY04, characterized miniaturization of a sensor based on Photoacoustic spectroscopy and leveraged use of quantum cascade lasers technologies for detection of hazardous chemicals; fabricated and characterized mid-wave IR vertical-emitter LEDs for IR scene projection; and conducted UV vertical emission experiments on aluminum gallium nitride (AlGaN) heterostructures. In FY05, characterize the chemical sensing concept using a photoacoustic system on a MEMS platform; characterize antimony-based resonant-cavity vertical-emitting IR LED and laser structures; investigate AlGaN-heterostrucuture mirrors and cavities for UV vertical emitters. In FY06, will evaluate MEMS photoacoustic sensor performance for feasibility as a trace-level chemical sensor; and will design high-bandwidth vertical-cavity near-IR emitters hybridized with electronics for communications. In FY07, will explore possible chip-level technologies (Quantum / Interband Cascade Lasers, MEMS microphones and MEMS actuators) for incorporation into MEMS photoacoustic chemical sensing system; and will fabricate novel mid-wave IR and UV resonant-cavity vertical emitters hybridized with electronics for OE sensors and scene projection.	2161	2103	1424	1471
- Investigate, design and fabricate micro electro mechanical system (MEMS) based components to improve power generation for the dismounted soldier and micro-cooling technology for both the soldier and Future Force systems. In FY04, improved compressor blades were fabricated using 3D fabrication methods and a micro-cooling system was designed to provide 250 watts /centimeters2 (W/cm2) of cooling. In FY05, fabricate high-temperature high-speed 3D power MEMs devices; implement systems to reclaim energy from small engines, fabricate micro-cooling systems capable of 250 W/cm2; and implement methods for fuel/air delivery for small engines and fuel cells. In FY06, will design and fabricate reclaimed energy systems for small engines; will fabricate components to provide fuel/air control on small engines and fuel cells; and will design and fabricate cooling systems that provide 500 W/cm2. In FY07, will characterize a fuel delivery and injection system for MEMS fuel pumps delivering 200mil per min and atomization systems that deliver 10um droplet sizes of fuel.	2582	2500	4500	4500

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Investigate and evaluate prognostics and diagnostics (P&D) algorithms; design, fabricate and evaluate micro-electro-mechanical systems (MEMS) and other sensors; and design, code, and evaluate database for the integration into decision systems to extend sensor rationalization and minimize downtime via condition-based maintenance. In FY04, designed and evaluated 1st wafer run of multi-level acceleration latch switches and showed combined MEMS and nanotechnology sensor concept models. In FY05, fabricate multi-level acceleration latch/reset switches for no power shock detection and monitoring; and conduct validating experiments on MEMS/nanotechnology sensors. In FY06, will investigate and evaluate advanced base-sensor suite, processor, and transceiver in distributed multi-node network. In FY07, will evaluate chemical and stress sensors for missile health monitoring.	2444	2815	2820	3294

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Investigate and mature silicon carbide (SiC) power device and packaging technologies to enable high temperature and power density converters for motor drive applications for Future Force (FF). Investigate technology for advanced batteries, fuel reformers and fuel cells to be used in hybrid power sources for FF electromagnetic armor and smart munitions. In FY04, fabricated and validated a 10 kilowatt (kW) SiC based high-temperature converter for alternating current motor control and 50 kW high-temperature SiC diode power modules for direct current–direct current (DC-DC) conversion applications; formulated and evaluated new catalysts for efficient hydrocarbon reformation for fuel cells and evaluated new electrolyte and energetic cathode material for lithium-ion (Li-ion) batteries; and investigated technology for advanced batteries and fuel cells to be used in hybrid power sources for FF. In FY05, implement high-temperature controller and DC-DC isolation circuits for high-power converters; investigate high temperature power converters for 10 kW mobile power applications; provide technology for an advanced high-energy rechargeable battery with enhanced user safety and high temperature charge retention; explore sulfur-removal absorbents for fuel cells. In FY06, will investigate and evaluate high-temperature SiC power converters implemented with current-controlled devices for medium power hybrid-electric vehicle (HEV) power conversion applications; provide electrode/electrolyte materials technology for enhancing charge/discharge rate of advanced Li-ion batteries and solvents for removing sulfides in military fuel for fuel cells. In FY07, will mature current controlled SiC power components; investigate/evaluate high-temperature SiC converters implemented with voltage-controlled devices for low power HEV power conversion; and provide improved electrolyte for low temperature Li-ion batteries and sulfur-tolerant catalysts for logistic fuel processing for fuel cells.	2075	2028	1870	1932
- The Army established a Flexible Display Center at Arizona State University to develop flexible display technology demonstrations for future vehicle and future Soldier applications. In FY04, established the center and developed test structures for flexible display active matrix backplanes (AM) with electro-optic devices. In FY05, investigate 2.5” diagonal AM reflective displays from research line. In FY06, this effort will be restructured into PE 0602705A Project H17 for increased visibility and management oversight.	3617	4641	0	0
- Flat Panel Displays/Flexible Display Initiative: In FY04, the objective of this Congressional add was to improve the quality of equipment and materials available from U.S. suppliers for flat panel display technologies. The add identified and inserted improvements into manufacturing, pre-production and pilot facilities; and established standards and manufacturing benchmarks for the flat panel display industry. No additional funding is required to complete this project.	3767	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Totals	29140	28166	22422	23783

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	21255	26406	23823	26686	28309	29395	30227	30441
H95	NIGHT VISION & EO TECH	21255	22092	23823	26686	28309	29395	30227	30441
K90	NIGHT VISION COMPONENT TECHNOLOGY (CA)	0	4314	0	0	0	0	0	0

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. Working in concert with Army Research Laboratory (ARL), this project will apply industry expertise in high volume, low cost electronic components and imaging systems to explore concepts for very low cost unattended ground sensors. 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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	22617	24488	27166
Current Budget (FY 2006/2007 PB)	26406	23823	26686
Total Adjustments	3789	-665	-480
Net of Program/Database Changes			
Congressional program reductions	-395		
Congressional rescissions			
Congressional increases	4500		
Reprogrammings			
SBIR/STTR Transfer	-316		
Adjustments to Budget Years		-665	-480

Change Summary Explanation:

Three FY05 Congressional Adds totaling $4500 were added to this PE.

FY05 Congressional adds with no R-2A:
($959) Enhanced Micro-Image Display Technology, Project K90: The purpose of this one year Congressional add is to evaluate the methods through which micro display wafers are processed, in order to investigate cost effective and viable components for enhanced micro-image display for future soldier-borne equipment. No additional funding is required to complete this project.

($959) Miniaturization Sensors for Small and Tactical Unmanned Aerial Vehicles, Project K90: The purpose of this one year Congressional add is to investigate existing or emerging sensor technologies and payload concepts necessary to satisfy mission requirements for small and tactical Unmanned Aerial Vehicles (UAVs). No additional funding is required to complete this project.

($2397) Third Generation Focal Plane Array (FPA) for Army Target Acquisition, Project K90: The purpose of this one year Congressional add is to develop a third generation Dual Color, Mid Wave and Long Wave 1280x720, small pixel infrared focal plane array for future joint combat systems. No ad

ditional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H95	NIGHT VISION & EO TECH	21255	22092	23823	26686	28309	29395	30227	30441

A. Mission Description and Budget Item Justification: This project funds efforts that 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. The Disposable Sensors effort, performed in concert with Army Research Laboratory (ARL), will apply industry expertise in high volume, low cost electronic components and imaging systems to explore concepts for very low cost unattended ground sensors. The Soldier Vision System Components effort 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. The Distributed Aided Target Recognition (AiTR) effort will research to dramatically reduce the time necessary to acquire targets, and collect intelligence data. The Lightweight Laser Designators effort will provide the capability to incorporate lightweight laser designators on small unmanned aerial vehicle (UAV) and unmanned ground vehicle (UGV) platforms and portable soldier systems. The Low Cost High Resolution Focal Plane Array (FPA) effort researches 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 using the Advanced Sensor Modeling and Simulation effort, and Sensor Modeling and Simulation Technology effort. In addition, this effort 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. The Multifunction Laser effort will assess and evaluate laser materials to produce a covert ladar system.

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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Disposable Sensors. In FY04, conducted design trade studies, determined initial sensor mix and studied exfiltration methodologies. In FY05, fabricate initial imaging and non-imaging data collection systems to collect and analyze multi-sensor modality data; devise and demonstrate initial embedded signal processing and fusion methodologies; investigate novel magnetic devices and signatures relevant to personnel detection in urban environments. In FY06, will identify and test new sensor modalities for personnel detection for use in urban and open environments and develop detection algorithms utilizing the new modalities; will investigate new uncooled imaging sensor modalities; will conduct research on miniaturization techniques for sensor electronics and component packaging designs. Will conduct research to reduce imaging sensor power consumption and optimize imaging techniques for low-bandwidth transmission. In FY07, will research and develop fusion algorithms incorporating the new sensor modalities to improve personnel detection; will develop and test miniaturized sensor components; will continue to identify and test new sensor modalities for personnel detection in urban and open environments and new uncooled imaging sensor modalities; will conduct research on increasing energy performance and reducing component size of sensor communications; will conduct research on imaging algorithms to develop aids to personnel discrimination.	1940	1906	3108	6377
Soldier Vision System Components. In FY04, fabricated imaging brass board helmet mounted 1280 x 1024 image intensifier and electron bombarded video-based mobility sensor and uncooled forward looking infrared (FLIR); fabricated a small pixel 1280 x1024 or larger color micro display and low power uncooled FLIR electronics; evaluated initial pixel fusion of multisensor imagery vision board sets with low light sensor and down selected the best design. In FY05, research 1280 x 1024 passive video-board low light sensors, miniature pixel fusion processor with advanced system control functions and low power 320 x 240 uncooled FLIR; investigate and evaluate large format (1600 x 1200/High Definition TV) low light video sensors for future soldier system efforts. In FY06, will evaluate first low power small pixel high dynamic range color microdisplays, dichroic (more than one color) combiner and variable density attenuator for see-through displays, and multi-spectral pixel-fusion processor. In FY07, will investigate low power high performance large format night imager and pixel fusion processor for multi-spectral fusion on a low power color head mounted display.	5314	5206	5702	4105

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Distributed Aided Target Recognition (AiTR) Evaluation Center of Excellence. In FY04, evaluated and assessed automatic and aided target recognition (ATR/AiTR) algorithms using experimental sensor imagery, obtained from field collection in multiple wavebands, for evaluating 3rd generation cooled sensor algorithms designed for FCS. In FY05, investigate baseline algorithm against hard targets and urban/clutter environments. In FY06, will research multispectral and hyperspectral ATR algorithm against hard targets and urban/cluttered environments. In FY07, will conduct phenomenology study of fusing multiple sensors against highly cluttered environments.	206	850	1299	1272
Lightweight Laser Designators. In FY04, established critical designator system specifications through experimental measurements and standard models; constructed initial laser designs and performed initial tests in laboratory. In FY05, build selected brassboard solid-state laser designs and test in the laboratory to verify energy output, beam quality and operation over temperature. In FY06, will transition the best laser designs to laser manufacturers for brassboard fabrication. In FY07, will research brassboard compact lasers meeting requirements for lightweight designators.	2083	2403	2256	2380
Low Cost High Resolution Focal Plane Arrays (FPA). In FY04, researched long wave FPA of Mercury-Cadmium Telluride (MCT) on Silicon (Si) and evaluated shorter time constant uncooled arrays, which resulted in improved imagery. In FY05, evaluate multi-band pixel interconnect approach, patterned thin-film filters on CdZnTe, and 1280x720 uncooled read-out integrated circuit (ROIC) design and fabrication. In FY06, will mature on-chip processing of multi-color IR sensors for target discrimination and clutter rejection; will create a 3 dimensional ROIC using vertically integrated sensor array technology that stacks silicon chips, resulting in improved situational awareness; will test the circuits in the laboratory to determine their efficacy in certain scenarios. In FY07, will mature and fabricate large area two-color HgCdTe arrays grown on a silicon wafer with the appropriate lattice matched buffer layers; will mature and fabricate large area (mega-pixel) uncooled arrays with small pixels (<20 microns) with a short thermal time constant and better temperature resolution.	7420	7158	6803	6800

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Sensor Modeling and Simulation. In FY04, delivered a new Field-of-View (FOV) search model for integration into the Combined Arms and Support Task Force Evaluation Model; completed construction and validation of a new performance model for emerging shortwave infrared sensor technology that enables US Forces to identify targets at the detection range of conventional electro-optical/infrared sensors, and delivered a networked sensors simulation testbed to Unit of Action Maneuver Battle Lab to support evaluation of Future Force/FCS technologies. In FY05, deliver new sensor and targeting task performance model that replaces current models, and complete beta version of "spectral" thermal sensor performance model to support 3rd Gen FLIR technology research program.	4292	4569	0	0
Sensor Modeling and Simulation Technology. In FY06, will mature advanced sensor performance and engineering models, and simulations to support technology assessments, acquisition decisions, and war-game simulations; will complete construction of performance model for fused infrared and image intensified sensors, and complete field of regard search model that includes performance in urban environments. In FY07, will complete and deliver performance model to evaluate sensors coupled with aided target recognition systems.	0	0	4655	4672
Multifunction Lasers. In FY07, will assess and evaluate laser materials to produce multiple wavelength bands and pulse modulation for covert ladar system	0	0	0	1080
Totals	21255	22092	23823	26686

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		25507	26279	19293	23037	22662	22650	22846	23013
H24	COUNTERMINE TECH	17561	17230	16674	20348	19861	19817	19988	20134
H35	CAMOUFLAGE & COUNTER-RECON TECH	2493	2530	2619	2689	2801	2833	2858	2879
HB2	COUNTERMINE COMPONENT TECHNOLOGY (CA)	5453	6519	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This Program Element (PE) studies and examines applied technologies to improve countermine, signature management and counter sensors capabilities for the Army's transformation to Future Combat Systems (FCS), the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. Project H24 focuses on concepts and technologies with potential to improve detection and neutralization of mines and improvised explosive devices (IEDs) while at a safe distance using ground and air platforms. The goal of this project is to increase mine and improvised explosive device detection search rates, reduce false alarm rates, and achieve precision neutralization capabilities in support of sustaining the high operational tempo needed in FCS and in Future Force operations. Working in conjunction with the US Army Engineering, Research and Development Center (ERDC), this project examines countermine phenomenology of booby-traps, improvised explosive devices, and surface and buried mines. 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. This PE addresses emerging mine threats in both the conventional and electronically activated categories, 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. Project H35 examines signature management techniques for tactical operation centers and counter sensor techniques to reduce the reconnaissance capabilities of our adversaries. Project HB2 funds Congressional special interest items.

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 Marine Corps. Work in this PE adheres to Tri-Service/Project Reliance Agreements on conventional air/surface weapons and ground vehicles. 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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, Virginia; the Army Corps of Engineer, R&D Center, Vicksburg, Mississippi; and the Armaments Research, Development, and Engineering Center, Picatinny, New Jersey.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	20547	20064	26768
Current Budget (FY 2006/2007 PB)	26279	19293	23037
Total Adjustments	5732	-771	-3731
Net of Program/Database Changes			
Congressional Program Reductions	-392		
Congressional Rescissions			
Congressional Increases	6800		
Reprogrammings			
SBIR/STTR Transfer	-676		
Adjustments to Budget Years		-771	-3731

Change Summary Explanation:
FY07 - Funds realigned ($3731K) to higher priority requirements.

Two FY05 Congressional Adds totaling $6800 were added to this PE.

FY05 Congressional adds with no R-2A:
($2685) Acoustic Technology for Landmine Detection, Project HB2: The purpose of this one year Congressional add is to investigate linear/non-linear acoustics for landmine and Improvised Explosive Device (IED) detection-based technologies. No additional funding is required to complete this project.

($3836) Polymer Based Landmine Detection, Project HB2: The purpose of this one year Congressional add is for investigation of an amplified fluorescence-quenching polymer (AFP) based sensor technology and its application as a mine detecting device. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H24	COUNTERMINE TECH	17561	17230	16674	20348	19861	19817	19988	20134

A. Mission Description and Budget Item Justification: This project examines new countermine technologies using man-portable, ground-vehicular, and airborne platforms for detection, discrimination and neutralization of individual mines, minefields, and improvised explosive devices (IEDs). These technologies support Future Combat Systems (FCS), the Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. The types of mines investigated include both conventional and electronically activated categories. This goal of this project is to detect mines with high probability, reduce false alarms, and increase operational tempo by performing data collection to assess the ability of various sensor combinations and signal processing/fusion algorithms. This project sponsors 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 Wide Area Airborne Minefield Detection effort will characterize a variety of airborne sensor technologies, tested in a variety of environmental conditions, to support wide area minefield detection. The Precision Mine Neutralization with Confirmation and Localization effort will increase the potential for sustained rapid movement of tactical forces using stand-off neutralization technologies. The FCS Mine Detection and Neutralization effort will provide forward-looking mine detection and neutralization. The Off Route Mine Detection and Neutralization effort will provide forward-looking mine and IED detection and neutralization, including side-attack detection, in an off-route environment within required rate-of-advance for Unit of Action (UA) minefield reconnaissance missions. The Countermine Phenomenology Studies effort will 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. The Sensors for Explosive Detection effort will provide short range standoff capability to detect explosives (such as IEDs, mines, and car bombs) 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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, Virginia; the Corps of Engineers RD&E Center, Vicksburg, Mississippi; the Armaments Research, Development, and Engineering Center, Picatinny, New Jersey; and the CERDEC Intelligence and Information Warfare Directorate, Fort Monmouth, New Jersey.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Center of Excellence for Unexploded Ordnance. In FY04, continued coordination effort within DoD for all unexploded ordnance (UXO) efforts to prevent duplication; continued update of the UXO database, which is a part of the JUXOCO website; conducted meetings, workshops, national and international symposiums for the purposes of sharing information and discussing UXO issues; conducted the UXO/Countermine Forum in March 04, which resulted in successful integration of efforts. In FY05, prepare the annual UXO Research and Development Plan, development of the UXO RDT&E Strategic Road Map, and conduct technology assessments; UXOCOE will incorporate Counter IED as the sixth mission area. In FY06, will coordinate requirements, integrate programs from the mission areas, and leverage the capabilities in other Government agencies, industry, academia, and the international community. In FY07, will continue to establish standards for testing, modeling, and evaluating Counter UXO technologies and ensure that requirements are current and accurate, opportunities for leveraging technologies are identified and exercised, duplicative programs are identified and eliminated, and information on programs and progress is shared.	475	486	500	500
Wide Area Airborne Minefield Detection. In FY04, held IPR for sensor selection, based on tests that characterized a variety of brassboard airborne sensors in terms of signal processing and clutter rejection in wide area minefield environments; continued test and characterization of modified sensors; pacing technologies included multi-spectral Long Wave IR/Short Wave IR (LWIR/SWIR), ultra wideband ground penetrating synthetic aperture radar, high resolution synthetic aperture radar (for scatterable mines), and creation of autonomous target recognition algorithms for clutter rejection. In FY05, obtain and analyze measurements in a wider variety of environmental conditions (soil conditions, temperature, humidity, ambient lighting, etc.) and collect extensive clutter data for building, testing and refining algorithms. In FY06, will evaluate the modified brassboard sensor design on multiple backgrounds; perform additional data collections with modified sensors; continue maturing optimized mini clutter detection algorithms and modules. In FY07, will assess technical and operational performance of prototype design after analyzing flight test data; provide recommended sensor design/specification, automatic target recognition algorithms and performance models for subsequent system prototype; transition to 6.3 system's program.	4936	5080	5670	7547

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Precision Mine Neutralization with Confirmation and Localization. In FY04, evaluated and selected neutralization technology options and performed mine neutralization study. In FY05, design and build precision neutralization breadboard components and subsystems, perform initial field experiments, and conduct analysis on collected data; begin building and testing point neutralization breadboard systems based on evaluation and assessment of prior field experiments. In FY06, will build cross-country acoustic-based mine confirmation and localization sensor data collection system(s); investigate landmine confirmation and localization signal processing and associated target recognition algorithms; with application to realistic data collected from field experiments; conduct joint field data collections with precision mine neutralization breadboard systems and confirmation and localization sensor data collection systems. In FY07, will combine multiple standoff mine confirmation, localization, and neutralization technologies onto a single, or integrated, platform; conduct field experiments against mines and IEDs in realistic on- and off-route environments; perform assessment of combined technologies.	683	3292	4637	5874
Future Combat Systems (FCS) Mine Detection and Neutralization. In FY04, conducted first blind tests of forward looking ground penetrating radar and infrared sensors; conducted field data collections for forward looking ground penetrating radar, acoustic, and infrared sensors. Conducted end-to-end testing with statistical results to compare against program exit criteria.	4837	0	0	0
Off Route Mine Detection and Neutralization. In FY04, examined a variety of forward looking detection technologies including ground penetrating radar and infrared, against improvised explosive devices (IEDs). In FY05, continue to examine and conduct evaluations of off route detection capabilities designed to provide FCS increased operational tempo and enhanced vehicle and soldier survivability.	3783	3858	0	0
Countermine Phenomenology Studies. In FY04, conducted analyses and investigations to characterize and predict the effects of the environmental, surface, and shallow subsurface conditions on sensor response and signal interpretation. In FY05, conduct an investigation of clutter encountered with various sensor modalities that will be used to predict and reduce false alarms. In FY06, will conduct site characterization and countermine sensing field experiments to determine predictive capabilities of improved geo-environmental models and assemble database of mines in background signatures. In FY07, will conduct blind countermine experiments at well characterized sites to evaluate model performance and clutter rejection improvements.	2847	3554	4447	4540
Sensors for Explosive Detection. In FY05, conduct initial studies on signatures of explosives and their behavior in various environments. In FY06, will investigate a field portable explosive detection sensor technology for data collection. In FY07, will conduct lab and field experiments of new portable sensors and evaluate performance.	0	960	1420	1887

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Totals	17561	17230	16674	20348

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H35	CAMOUFLAGE & COUNTER-RECON TECH	2493	2530	2619	2689	2801	2833	2858	2879

A. Mission Description and Budget Item Justification: This project designs, develops, and investigates advanced signature management and deception technologies for masking friendly force capabilities and intentions. These technologies support Future Combat Systems (FCS), the Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. The Low Cost Counter Reconnaissance Technology effort 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 FCS/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 the Future Force. The Advanced Electronic Deception Techniques effort will investigate spectral characteristics of targets and backgrounds to determine optimum filter bands; spatial resolution requirements; spatial and spectral registration requirements; and sensor noise effects.

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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Low Cost Counter Reconnaissance Technology. In FY04, constructed first version of a background database and pattern generation software to determine new low cost measures to defeat hyperspectral sensors, fabricated new reduced signature uncooled infrared (IR) focal plane arrays (FPA), and determined the laser vulnerabilities of advanced uncooled IR sensors. In FY05, integrate new FPAs and optics into a prototype uncooled IR sensor and fabricate advanced paints and patterns incorporating spectral signature reduction. In FY06, will perform field experiments to validate optical augmentation and spectral signature reductions.	2493	2530	2619	0
Advanced Electronic Deception Techniques. In FY07, will investigate spectral characteristics of targets and backgrounds to determine optimum filter bands, spatial resolution requirements, spatial and spectral registration requirements and sensor noise effects.	0	0	0	2689
Totals	2493	2530	2619	2689

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	23884	20656	17482	18160	18469	18607	18767	19101
H70	HUMAN FACT ENG SYS DEV	18527	16629	17482	18160	18469	18607	18767	19101
J20	OMNI DIRECTIONAL TREADMILL UPGRADE	5357	0	0	0	0	0	0	0
J21	HUMAN FACTORS APPLIED RESEARCH CA	0	4027	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program investigates and evaluates 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, and 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 PE is related to, and fully coordinated with, efforts in PE 0602601 (Combat Vehicle and Automotive Advanced Technology), PE 0602786 (Warfighter Technology), PE 0602120 (Sensors and Electronic Survivability), PE 0602784 (Military Engineering Technology), PE 0602783 (Computer and Software Technology), PE 0602308 (Advanced Concepts and Simulation), PE 0603005 (Combat Vehicle and Automotive Technology), PE 0603710 (Night Vision Advanced Technology), PE 0603015 (Next Generation Training and Simulation) and PE 0603007 (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).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	16899	18181	18707
Current Budget (FY 2006/2007 PB)	20656	17482	18160
Total Adjustments	3757	-699	-547
Net of Program/Database Changes			
Congressional Program Reductions	-302		
Congressional Rescissions			
Congressional Increases	4200		
Reprogrammings			
SBIR/STTR Transfer	-141		
Adjustments to Budget Years		-699	-547

Change Summary Explanation:

One FY05 Congressional add totaling $4200 was added to this PE.

FY05 Congressional Add with no R-2A:
($4028) Manpower and Personnel Integration (MANPRINT), Project J21: The purpose of this one year Congressional add is to fund research in manpower and personnel integration. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H70	HUMAN FACT ENG SYS DEV	18527	16629	17482	18160	18469	18607	18767	19101

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 Combat System (FCS) 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 Unit of Action (UA) Maneuver Team 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 (SSTC); 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 2004	FY 2005	FY 2006	FY 2007
- 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. In FY04, identified organizational, cultural, and cognitive factors to enhance decision making in the network-centric future force; assessed the functionality and usability of tactical visualization tools for commander decision making in time constrained environments; and generated models to examine the effect of missing or partial information as a predictor of decision quality. In FY05, determine and transition critical performance requirements for prototype information displays; and determine metrics to assess the training effectiveness of interactive simulation technology. In FY06, will refine decision aids to optimize visualization and information sharing requirements in the UA; and will investigate the usability and effectiveness of interactive technology for immersive training scenarios. In FY07, will validate a suite of tools to improve C2 capabilities in uncertain and urban environments; and will conduct cognitive task analysis of multi player training modules.	3452	3444	3720	4201

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Enhance human performance modeling tools to optimize soldier machine interactions for FFW and FCS. Collect empirical data on human perception (vision and hearing) to support the development and validation of human and system performance models. In FY04, verified and distributed Improved Performance Research Integration Tool (IMPRINT) version 7; applied the hearing hazard model to firing weapons in urban enclosures and tunnels to specify hearing protection requirements; collected acuity measurement under various luminance levels (ranging from a quarter-moon to dark, overcast day, with the chart illuminant having the spectral distribution of starlight) and transitioned data to CERDEC to support visual acuity modeling. In FY05, link vehicle dynamics, biodynamics, and anthropometric modeling capabilities to extend soldier centered design tools; develop architectures for modeling human performance of system of systems (SoS) through linked IMPRINT models and the Modeling Architecture for Technology and Research Experimentation (MATREX); validate activity-based target acquisition model comparing surveillance techniques used by military and civilian law enforcement. In FY06, will incorporate ability to model human performance in joint operations with IMPRINT 8 (Pro); will develop a model for visual performance prediction for monocular, binocular, and biocular helmet mounted displays (HMDs). In FY07, will identify and apply analysis metrics aimed at distinguishing performance of teams embedded within SoS and joint operations; will create and distribute a protected web-based repository of human performance models used in Manpower and Personnel Integration (MANPRINT) analyses; and develop a model of minimum tolerance values of optical disparities for monocular and binocular HMDs under static and dynamic conditions and transition to Army Aeromedical Research Laboratory and special operations community.	2307	2608	2750	2899

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- 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 FY04, initiated modeling of driver performance to examine design implementations for ground vehicles, examined a concept head mounted display for driving and created a quantifiable model of the interactions effects of multimodal controls and displays; began integrating models with ride motion simulators environments to correlate real world with simulation. In FY05, extend motion-based simulation validation with multimodal modeling approaches to provide an integrated approach to analysis of multiple crew station issues. In FY06, will further extend mitigation solutions to a broad cross section of ride problems and integrate with multimodal display and control approaches for a complete solution. In FY07, will consolidate crew station guidelines for designers of future vehicles to provide a basis for next generation enhancements.	2184	2155	2260	2350

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Investigate and determine interface design solutions for UA 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 FY04, modeled communication and messaging processing of operators with various information display options; completed six FCS vehicle variant models and a dismounted model to identify tasks with high potential for cognitive overload, the sensory channel loadings for these tasks, as well as their associated critical information requirements; investigated highest risk tasks in field evaluations; an investigation on the impact of increased information on Future Force workload identified an increase in shooting errors with helmet mounted displays (HMD) as compared to both auditory and wrist mounted conditions (PDAs); characterized the ability of UA soldiers to obtain situational understanding based on sensor design and density; evaluated relationships among cognitive performance and stress response variables and analyzed differences between various encapsulation configurations. In FY05, refine the models matured in FY04 using newly gathered field data; conduct further experiments for model validation for integration into force-on-force models; provide interface design solutions to FFW; conduct decision cycle time model validation studies. In FY06, will refine the models, run final experiments using displays that provide information across the soldiers' sensory modalities, and publish display design guidelines for FCS based upon the experiment and model results. In FY07, will mature physics-based models of human locomotion to research soldier load and range of motion of future systems; and will evaluate soldier physical and cognitive performance using prototype FFW Soldier systems.	4239	4526	4673	4864

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Improve human robotic interaction (HRI) in a full mission context. In FY04, determined common operational definitions of Soldier-robot interaction in concert with tri-service, university and industry programs to advance a common understanding of issues and metrics; conducted task and workflow analysis of soldier robotic interactions for FFW- FCS missions with multitasking; and investigated specialized Operator Control Unit (OCU) technologies to improve Soldier robotic team performance focusing on 3-D stereo interfaces, multimodal interfaces, and non-intrusive workload measures for adaptive systems. In FY05, model cognitive workload and performance in multi-task conditions at the system of system level; examine workload, levels of autonomy, shared situation awareness, and soldier performance for scalable OCU concepts; determine requirements for mixed asset control and workload management for mounted and dismounted missions; and investigate Soldier-robot team performance and workload using realistic simulation environments. In FY06, will examine effects of situational uncertainty, user expectancies, task interruption, knowledge representation, and adaptive automaton on HRI using realistic simulations of FCS and FFW missions; will Investigate OCU concepts during field experimentations and transition results to the TARDEC; and will investigate HRI implications of mixed asset teaming concepts in realistic simulation or field experiments. In FY07, will address Soldier-robotics team performance using models and metrics with the goal of identifying optimal systems for particular operational contexts and understanding the implications of each; and will utilize metrics and diagnostics to determine optimal span of control and adaptive automation for mounted and dismounted Future Force missions using aerial and ground unmanned systems.	4018	3896	4079	3846
- Human System Interaction Modeling: This one year Congressional add augmented human performance modeling tools via the release of the IMproved Performance Research Integration Tool (IMPRINT) version 7. No additional funding required to complete this project.	2327	0	0	0
Totals	18527	16629	17482	18160

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602720A - Environmental Quality Technology

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	30642	22369	16417	17379	16897	16420	16279	16562
048	IND OPER POLL CTRL TEC	3646	4000	2828	2902	2977	3007	3033	3056
835	MIL MED ENVIRON CRIT	3099	3383	3065	3140	3250	3281	3310	3334
895	POLLUTION PREVENTION	0	1079	3406	4532	3708	4014	3766	3957
896	BASE FAC ENVIRON QUAL	8724	7941	7118	6805	6962	6118	6170	6215
EM5	ENVIRONMENTAL QUALITY APPLIED RSCH - AMC (CA)	6428	4793	0	0	0	0	0	0
F25	MIL ENV RESTOR TECH	1927	117	0	0	0	0	0	0
F35	ENVIRONMENTAL QUALITY APPLIED RESEARCH (CA)	6818	1056	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this program element is to provide technologies that will improve the Army's ability to comply with requirements mandated by federal, state and local environmental/health laws and to reduce the cost of this compliance while supporting the long-term sustainment of Army training and testing activities. 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). Work in this program element is performed by 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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	17026	17880	20198
Current Budget (FY 2006/2007 PB)	22369	16417	17379
Total Adjustments	5343	-1463	-2819
Net of Program/Database Changes			
Congressional Program Reductions	-328		
Congressional Rescissions			
Congressional Increases	6100		
Reprogrammings			
SBIR/STTR Transfer	-429		
Adjustments to Budget Years		-1463	-2819

Change Summary Explanation:
FY07 - Funds realigned ($2819K) to higher priority requirements.

Two FY05 Congressional adds totaling $6100 were added to this PE.

FY05 Congressional adds with no R-2A:
($1056) Biological/Chemical Materials Environmental Modeling, Project F35: The purpose of this one year Congressional add is to modify and enhance the Army Risk Assessment Modeling System to address environmental terrorism threats. No additional funding is required to complete this project.

($1056) Hawthorne Army Depot, Project EM5: The purpose of this one year Congressional add is to upgrade the Hawthorne Army Depot. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
048	IND OPER POLL CTRL TEC	3646	4000	2828	2902	2977	3007	3033	3056

A. Mission Description and Budget Item Justification: This applied research project provides technologies to enable the Army to reduce or eliminate the effects of legal and regulatory environmental restrictions on installation facilities, training and testing lands, and ranges, as well as to avoid fines and facility shutdowns. New and innovative technologies are essential for the effective control and reduction of military unique hazardous and non-hazardous wastes on military installations. 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, to include deconstruction processes. The intent is to provide compliance through sustainable environmental protection technologies. Additional work is focused on decreasing noise pollution from training operations and 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). Work in this project is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Industrial Activities Readiness - In FY04, determined best practices for Army recycled-concrete, other construction/demolition debris, and other Army solid waste including that contaminated by lead-based paint and energetic compounds in order to reduce disposal costs, protect human health and the environment and maintain sustainable installations. In FY05, mature physiochemical and biosorbent treatment technologies for wastewater from munitions production allowing cost effective treatment while maintaining mission readiness. In FY06, will complete a review of promising energetic materials treatment technologies for the safe removal and reuse of energetics contaminated building materials at Army Ammunition Plants. In FY07, will develop bench treatment technologies for perchlorate commingled with explosives.	1412	1478	1780	1964

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Sustainable Live-Fire Range Design and Maintenance – In FY04, developed a risk assessment quantification methodology to evaluate level of environmental risk related to training range planning and designs; matured a risk assessment protocol that identifies environmental compliance risks to ranges and incorporates approaches for mitigation of these risks. In FY05, mature application of the range risk assessment protocol through a framework of integrated range and munitions modeling. Training and Test Range Noise Control – In FY04, improved sound propagation algorithms for air-to-ground and ground-to-ground noise model enhancement. In FY05, integrate noise models for artillery, small arms and aircraft to better characterize the full effects of military training noise on people in the vicinity of installations. In FY06, will investigate human response to infrequent noise events. In FY07, will integrate noise tools into Army range design protocols.	2234	2522	1048	938
Totals	3646	4000	2828	2902

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
835	MIL MED ENVIRON CRIT	3099	3383	3065	3140	3250	3281	3310	3334

A. Mission Description and Budget Item Justification: This applied research project provides 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 contaminant concentration levels that will protect the environment and human health from adverse effects. This research supports the Army Risk Assessment and Modeling System (ARAMS). The ARAMS links models of expected result and transport to the exposure and effects models and databases of explosives and their degradation by-products. New research using toxicogenomics and molecular modeling tools for toxicity and exposure assessment will further reduce 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 rational safe cleanup and discharge levels at Army installations. The Long-Term Monitoring program provides a means of monitoring military unique contaminants during remedial actions and site closure during near-real-time in situ monitoring using miniaturized sensors for use in the field. This will reduce or eliminate the costly and lengthy operation of off-site analyses and enhance overall monitoring capabilities by providing continuous/autonomous detection/analysis. 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 U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi, and the Center for Health Promotion and Preventive Medicine located at Aberdeen, Maryland.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Land Remediation/Hazard/Risk Assessment Tools for Military Unique Compounds; Long Term Monitoring for Army Ranges; Characterization/Assessment and Remediation of Distributed Source Ordnance Related Compounds (ORCs) on Army Ranges – In FY04, generated a compendium of analytical methods applicable to military contaminants and established the scientific basis for real-time in situ long term monitoring systems; investigated the characterization and transport of distributed explosives contaminants relative to active/inactive military testing and training ranges. In FY05, provide screening tools for the development of an in situ, real-time contaminant concentration level monitoring system for long term monitoring for installations and ranges to significantly reduce the need for laboratory testing and the associated sample handling requirements; continue studies to determine the transport properties and characteristics of military relevant contaminants associated with training and testing ranges; will evaluate new and innovative toxicogenomic and computational biology methods to develop predictive toxicology models that improve ecological risk assessment and range management of ORCs. In FY06, will identify rapid, statistically based sampling and innovative analytical methods and protocols for ORCs assessment on Army ranges; will identify novel contaminant extraction and field measurement methods for on-site long term monitoring, will design a computational biology virtual simulation for predictive toxicology analogous to a “Canary in a Coal Mine” for mammalian organisms. In FY07, will identify novel contaminant detection systems and measurement protocols for near-real-time, on-site long term monitoring; will integrate a distributed source contaminant transport model into the ARAMS; will continue development of a computational biology virtual simulation for predictive toxicology analogous to a “Canary in a Coal Mine” for mammalian organisms.	3099	3383	3065	3140
Totals	3099	3383	3065	3140

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
895	POLLUTION PREVENTION	0	1079	3406	4532	3708	4014	3766	3957

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 will mature 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 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 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). Work in this project is performed by the Army Research Laboratory in collaboration with the Armaments Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ and the Aviation and Missile Research, Development and Engineering Center (AMRDEC), Huntsville, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Rockets and Missile Propellants - In FY05, begin to model and conduct small-scale laboratory evaluations of environmentally benign rocket and missile propellants. In FY06, will test new prototype propellants. In FY07, will transition first generation of environmentally benign rocket and missile propellants, including minimum signature propellants that are lead and perchlorate free, and gelled propellants that do not contain hydrazine or monomethylhydrazine. Conventional Munitions and Pyrotechnics – In FY05, evaluate new non-toxic, non-polluting burn rate modifiers, deterrents, and modifiers. In FY06, will design novel non-polluting propellants, explosives and pyrotechnics, and complete performance evaluation of environmentally benign explosives. In FY07, will identify and develop methods for neutralizing low order detonated exploded ordnance through internally induced microbial attack. Primers, Initiators and Fuzes – in FY07, begin to model and identify environmentally benign primers, initiators and fuzes that are free from persistent, toxic, and bio-accumulative chemicals.	0	1079	3406	4532
Totals	0	1079	3406	4532

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
896	BASE FAC ENVIRON QUAL	8724	7941	7118	6805	6962	6118	6170	6215

A. Mission Description and Budget Item Justification: The objective of this 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. The Army will be provided 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 will 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 affect mission support and environmental compliance. The project will also provide advanced methods and technologies to restore lands damaged during training activities and allow sustained use of installation facilities and training land resources. 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 U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Threatened and Endangered Species (TES) Management to Reduce Operational Constraints – In FY04, expanded impact assessment protocols developed for the red-cockaded woodpecker to examine habitat impacts from land management practices. In FY05, analyze the effects of military training and land management on high priority TES to support the reduction/elimination of training restrictions. In FY06, will develop spatial assessment technology for seven high priority species on Army lands and produce refined population and population goal analysis protocols that are region-based. In FY07, will quantify impacts of military land management on TES.	3163	3556	3785	2985

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Predictive Risk Assessment and Management for Army Ranges and Training Lands – In FY04, analyzed selected range design features and recommend improvements to reduce environmental compliance requirements; assessed range munitions load and environmental factors that may impact long term sustainability of range operations. In FY05, prepare an engineering analysis of costs associated with life-cycle operations and maintenance of environmentally compliant range designs to reduce and facilitate maintenance, cleanup of munitions and scrap, and erosion control; refine design and operation of maintenance criteria for sustainable ranges that incorporate environmental compliance considerations. In FY06, will complete a range compliance monitoring and carrying capacity module focusing on munitions that will be incorporated into the modeling platform consistent with the Installation Training and Maintenance (ITAM) Army Training and Testing Area Carrying Capacity (ATTACC) methodology.	2580	1605	166	0
Reconfigurable and Joint Ranges – In FY04, formulated particulate matter emission estimation models for tactical vehicle engines and chemical/physical particulate matter control technologies for unpaved surfaces; linked mission-use constraints to a community growth model. In FY05, complete noise dose-response model augmentation and noise mitigation practice development for typical training operations; mature technology for field measurement of particulate matter concentrations from Army training activities that enable estimates of impacts of training on local and regional air quality; mature Military Landuse Evolution and impact Assessment Model (MLEAM) to facilitate strategic plans to support long term military landuse sustainment. In FY06, will conduct cost benefit analysis for land rehabilitation projects that will improve erosion control practices and prioritization of sites for land rehabilitation in support of sustainable training lands. In FY07, will develop ATTACC protocols that incorporate non-military land and natural resource stressors.	2780	2780	3167	3820
Installation Operations/Hazardous Air Pollutants (HAP) – In FY04, matured demilitarization furnace air emission control system that will include metal adsorption and high temperature filtration; transitioned HAP applied research products to advanced technology demonstration.	201	0	0	0
Totals	8724	7941	7118	6805

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	18416	27416	21787	22792	24384	24804	25021	25207
779	C2 & PLAT ELEC TECH	7708	8252	9051	9614	10178	10475	10566	10643
H92	COMMUNICATIONS TECH	10708	10056	12736	13178	14206	14329	14455	14564
TR9	C3 COMPONENT TECHNOLOGY (CA)	0	9108	0	0	0	0	0	0

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, presentation of information and decision-making. This will be achieved by improving the command, control, and communication systems (e.g. man-machine interface, 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 research on infrastructures that allow timely distribution, display, and use of C2 data on Army platforms. This research also includes enhancements to the Global Positioning System (GPS) user equipment to provide a more robust, anti-jam capability, and improvements to man-machine interfaces and decision aids for increased operation tempo in an On-the-Move (OTM), network-centric battlefield environment. Project H92, Communications Technology, funds research that will provide technologies that allow 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 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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	18604	19705	20001
Current Budget (FY 2006/2007 PB)	27416	21787	22792
Total Adjustments	8812	2082	2791
Net of Program/Database Changes			
Congressional Program Reductions	-259		
Congressional Rescissions			
Congressional Increases	9500		
Reprogrammings			
SBIR/STTR Transfer	-429		
Adjustments to Budget Years		2082	2791

Change Summary Explanation:
FY06 - Increased funding ($2082K) supports improved fidelity modeling & simulation for network design
FY07 - Increased funding ($2791K) supports improved fidelity modeling & simulation for network design

Three FY05 Congressional adds totaling $9500 were added to this PE.

FY05 Congressional Adds with no R-2A:
($1438) All Digital Transceiver (ADT) Development, TR9: The purpose of this one year Congressional add is to develop an All Digital Transceiver to replace the Joint Tactical Radio System (JTRS) Cluster 1's existing analog transceiver. No additional funding is required to complete this project.

($5754) Enhanced Wireless Digital Communications for Urban First Responders, TR9: The purpose of this one year Congressional add is to develop wearable wireless RF-location and digital communications system development of the First Responder Communication System. No additional funding is required to complete this project.

($1918) Portable Flexible Communication Display Device, TR9: The purpose of this one year Congressional add is to develop a portable flexible

electronic display communication device which can be rolled up into a small, light-weight package and unrolled for on-the-move commanders. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
779	C2 & PLAT ELEC TECH	7708	8252	9051	9614	10178	10475	10566	10643

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. The Future Force will require leaders at all levels to have continuous situational awareness to make informed and rapid critical decisions to "shoot, move and communicate" more quickly than the adversaries. This project does 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, freed from their command posts and while On-the-Move (OTM). Emphasis is on course of action determination and analysis, 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 advanced high resolution and large screen displays, 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 & 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 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 the Unit of Employment (UE) and Future Combat Systems (FCS) Unit of Action (UA). Networked Sensors for the Future Force designs and develops a C2 information infrastructure to prioritize information flow, based on user requirements and a standardized technique of tasking networked sensors and unmanned 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, Development and Engineering Command, Communications-Electronics Research, Development, and Engineering Center (CERDEC), Fort Monmouth, NJ.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Battle Space Awareness & Positioning: In FY04, evaluated positioning, navigation, and tracking prototype-integrated systems including RF ranging (hardware and algorithms), an enhanced pedometer system, and a network assisted Global Positioning System (GPS) in laboratory environments; conduct field test on components to evaluate potential use in military operations in urbanized terrain. In FY05, integrate best performing components into a complete positioning, navigation and tracking system for dismounted soldiers in complex and urban terrain; perform laboratory evaluation, and prepare for field testing of breadboard system; conduct investigation in performance improvements for Micro-Electro Mechanical System (MEMS) Inertial Measurement Units (IMUs) for integration within the context of an integrated navigation system for dismounted soldier and tactical vehicle applications. In FY06, will conduct field test assessments of the integrated dismounted urban position/navigation technology; will complete the investigation of performance improvements for MEMS IMUs for dismounted soldier and tactical vehicle applications. In FY07, will mature positioning/navigation sensor and integration technologies to support robust affordable configurations for manned/unmanned tactical vehicles and dismounted soldiers.	1475	3418	3381	2802
- C2 OTM Enabling Technologies: In FY04, investigated intelligent agent software for execution monitoring of 100 events and matured mobile adaptive computing capabilities for dispersed and on-the-move C2 operations; identified tactical scenarios to evaluate decision aids and mobile C2 tools, and provided early prototypes utilizing an information management scheme based upon information exchange requirements for use in C2 functions in complex and urban terrain. In FY05, mature selected tactical decision aids transitioning from the Army Research Laboratory; identify requirements for a distributed collaboration environment, and construct a network-centric software environment for mobile decision tools to support C2 functions in complex and urban terrain; conduct an assessment of intelligent agent technology within CERDEC, National Labs, industry and academia and determine candidate applications for agents in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR). In FY06, will implement intelligent agent based C4ISR applications and conduct initial technical experiments to quantify performance. In FY07, will conduct operational experiments to support the transition, integration and validation of intelligent agent technology and provide a repository for agent technology and re-use.	3733	1834	1537	2282

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Networked Enabled Battle Command: In FY05, investigate software technology for automated retrieval of mission-relevant Battle Command information across heterogeneous Service-Based Architectures. In FY06, will design and develop software technology capable of intelligently regulating/prioritizing flow of information between low bandwidth (UA) and higher bandwidth (UE) networks based on understanding of network status and battle context, such that UA network performance is maintained while optimizing net-centric information flow across echelons; will investigate 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, will investigate advanced effects based decision models that automatically match emerging patterns in COP and mission to knowledge base of recommended decisions for a given situation; will investigate automated wargaming tools that allow UE commanders to project potential effects of decisions and assess sensitivity of alternate options on future battle state.	0	2000	4133	4530
- Networked Sensors for the Future Force: In FY04, modeled the behavior of the C2 information system using Unified Modeling Language to demonstrate the flow of information between operators, the collaboration between networked subsystems, and the information exchange with unmanned platforms; evaluated Common Object Request Broker Architecture as a means of information exchange using a publish/subscribe model. In FY05, integrate the infrastructure and test in field experimentations with unmanned networked sensors and platforms.	2500	1000	0	0
Totals	7708	8252	9051	9614

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H92	COMMUNICATIONS TECH	10708	10056	12736	13178	14206	14329	14455	14564

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). Dynamic Readdressing and Management for the Army (DRAMA) investigates mobile ad hoc protocols and network management technologies enabling, robust, on-the-move communications. The Advanced Antennas effort designs and develops tactical antenna technologies to reduce cost, the number required, and increase the range and throughput, while increasing platform survivability by reducing the antenna visual signature. Free Space Optical/Near-Optical Communications (FOCUS) investigates wireless technologies for hostile mobile environments using laser communications. The Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) and Modeling & Simulation (M&S) for Network Designs efforts develop 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 proven through modeling and simulation. Radio Enabling Technologies and Nextgen Applications (RETNA) designs and develops affordable radio components and enabling technologies to improve Cluster 1 Joint Tactical Radio range, throughput and reliability performance. The Next Generation Satellite Communications effort investigates low cost, low profile OTM Ka and EHF band satellite communications hardware and software. 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. Future Force Antennas designs and develops affordable directional antenna systems to support directional networking communications in mobile terrestrial (line of sight) environments. The Joint Tactical Radio System (JTRS) Squad-Level Communications effort develops mobile wireless technologies for emerging wideband waveforms to meet the size, weight and power needs of the individual dismounted soldier and unattended ground sensors.

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 2004	FY 2005	FY 2006	FY 2007
- Dynamic Readdressing and Management for the Army (DRAMA): In FY04, conducted experiments to determine the maturity of intelligent agent and mobile agent software network management tools using an intelligent agent framework for automated network control and management of traffic flow (voice, data, video) over the network; determined the operational capabilities of dynamic addressing and network reconfiguration based upon the intelligent agent assessment of network dynamics. In FY05, will evaluate enhanced automated network management tools for large, tactical, OTM networks to include integration with net management agents, enhanced intelligent agents, and scalability of dynamic readdressing and Internet Protocol (IP) multicast protocols along with network management tools; will research, analyze, and evaluate conceptual technical architecture/framework, advanced technologies, correlation algorithms, and dynamic database mapping techniques to support the Network Operation concept of an integrated Network Management, Information Assurance, and Information Dissemination Management capability.	4000	4847	0	0
- Advanced Antennas: In FY04, completed modeling for body-wearable, multi-band antennas, and platform antenna placement; conducted initial human radio frequency safety assessment model; completed K/Ka band array development platform. In FY05, investigate technologies for a family of Rotary Wing Aircraft multi-band antennas, lightweight body-wearable antennas (helmet and vest), and low profile vehicular antennas to comply with JTRS communications requirements for various ground and air platforms. In FY06, will complete design of body-wearable, low profile and rotary wing aviation antennas.	2100	1100	1200	0
- Free Space Optical/Near-Optical Communications (FOCUS) and Sensors Networking: In FY04, refined sensor communications requirements; integrated protocols and waveforms into model hardware; designed subsystem including transmitter laser, tracking hardware, down conversion (extract data from laser) unit. In FY05, conduct early laboratory experiments to establish performance against program goals and evaluation criteria for ground sensors and conduct laboratory experiments emphasizing subsystem investigation.	3820	2100	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) and Modeling & Simulation (M&S) for Network Designs: In FY05, investigate and design open system architecture to ensure interoperability with multiple waveforms and systems; perform analysis of technologies for the predictive network planner and dynamic 2D/3D visualization tools to integrate into COMPOSER architecture. In FY06, will conduct laboratory testing of COMPOSER technology and evaluate technology from Training & Doctrine Command (TRADOC) Battle Lab Collaborative Simulation Environment (BLCSE) experiment result data; will utilize parallel and distributed computing technologies to analyze performance behavior; will perform assessment to address the challenges of ad hoc communication network performance capabilities; will assess and characterize performance of the higher physical data link and network layers through M&S. In FY07, will perform analysis of available radio models and waveforms and integrate the waveforms into the COMPOSER architecture; will evolve modeling and simulation processes and technologies by using the FCS network as a baseline to enable the understanding and validation of the principles and rules that govern the behavior and performance of complex communication network of the future; will assess and characterize RF environment; characterize detailed end-to-end user performance metrics; assess implementation of new networking technologies and influence emerging network designs with M&S.	0	1069	4789	4410
- Radio Enabling Technologies and Nextgen Applications (RETNA): In FY05, leverage existing Wideband Power Amplifier (WBPA) technology to develop a WBPA for risk reduction for JTRS Cluster 1 that is capable of meeting the link closure requirements for ground applications; evaluate the application of passive graphite foam thermal management technology by testing against a Cluster 1 emulated circuit board with hot spots. In FY06, will begin the Cluster 1 rotary wing Electromagnetic Interference (EMI) filter effort concentrating on new design techniques and compact filters that enable the reduction of filter size, weight, and power while maintaining the required military standard interference suppression requirements; will begin design of an integrated superconducting-based all-digital transceiver that enables increased performance, sensitivity, and channel capacity in same package as the existing analog design. In FY07, will begin laboratory development and integration of the all-digital transceiver by integrating products of multiple Army, Navy, and Air Force investments.	0	940	2846	2922

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Next Generation Satellite Communications (SATCOM): In FY06, will develop a passive receiver assembly for a low cost, low profile, wideband (Ka and EHF) on-the-move satellite antenna; will begin design of a K-band (20-30Ghz) superconducting-based all-digital receiver for satellite communications based on developments in the RETNA program; will begin design of network and processing satellite aware OTM blockage mitigation and avoidance protocols. In FY07, will evaluate an active transmit assembly for a low cost, low profile, wideband (Ka and EHF) on-the-move satellite antenna; will develop the analog to digital converter component of the K-band superconducting-based all-digital receiver; will analyze and evaluate performance of network and processing satellite aware OTM blockage mitigation and avoidance protocols in a simulated environment.	0	0	2791	2336
- Tactical Wireless Network Assurance (TWNA): In FY06, will provide intrusion detection algorithms for FCS UA; will evaluate 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; will laboratory test adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time. In FY07, will design and perform laboratory testing of adaptive security alert correlation, visualization and response to tactical wireless network security events in near-real time by providing a 40% reduction in intrusion response time; will evaluate database access control and authentication of mobile data elements that restrict unauthorized modification to mobile code by preventing unauthorized access on a 50 node ad hoc network.	0	0	1110	1611
- Future Force Antennas: In FY07, will M&S to quantify the cost versus performance tradeoffs for directional antennas; will develop directional antenna systems based on the results of M&S effort; will conduct analyses of one dimensional beam steering and elevation beam shaping for ground to air nodes and architectures that lead to affordable systems; will conduct M&S to validate parameters and link connectivities within the directive network; will initiate development of distributed digital signal processing techniques to allow combining of signals from multiple apertures integrated around a platform.	0	0	0	1899
- Joint Tactical Radio System (JTRS) Squad-Level Communications: In FY04, completed software integration of Soldier Radio Waveform (SRW) Increment 0.5 in the JTRS Squad Level Communications Project brassboard to include the Core Framework, SRW application software, digital baseband processing, and the frequency agile RF front-end operating in the 225-1000 MHz band.	788	0	0	0
Totals	10708	10056	12736	13178

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Y10	COMPUTER/INFO SCI TECH	3939	3862	3590	3705	3819	3842	3875	3903

A. Mission Description and Budget Item Justification: This program element researches and applies information and communications technology to enhance understanding and speed the decision cycle for commanders operating in the mobile dispersed environment envisioned for the Future Force. Focus is on providing widely applicable solutions that can be applied across the spectrum of command and control (C2) problems. This program investigates and matures command, control, communications (C3) software and components to increase Future Combat System (FCS) and Future Force lethality and survivability through improved commanders' decision-making and situational awareness and, where feasible, exploits opportunities to enhance Current Force capabilities. The goal of this program element is to develop technologies to automate the collaboration for decision making (planning, rehearsal and execution) so that it is synchronized, parallel and real-time, and to devise collaboration tools to support both the staff and the Commander. Challenges for this program include developing automated tools to support the flow and synchronization of secure data/information from humans to humans, from humans to computers, from computers to humans, as well as reducing dependence on mouse and keyboard versus other modes of computer interaction. Work in this PE is related to and fully coordinated with efforts in PE 0602782(Command, Control, Communications Technology), PE 0603772(Advanced Tactical Computer Science and Sensor Technology), and PE 0603008(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 2004	FY 2005	FY 2006	FY 2007
- Enhance information processing techniques necessary to improve military decision making through software agent technologies, heterogeneous collaborative agent architectures, data mining, soft computing, and advanced reasoning techniques. In FY04, provided to the Communication Electronics Research, Development and Engineering Center (CERDEC) user and situation adaptive (execution-centric) technologies to assist Commanders in the Military Decision Making Process (MDMP). In FY05, provide user-directed fusion techniques that combined with CERDEC's techniques will enable 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 and FCS assessment. In FY06, will finalize user-directed mining and system architecture, based on FY05 assessment. In FY07, will finalize Knowledge Extraction system and initialize transition process to user community of technologies that provide the right information at the right time to the commander and soldier with reduced cognitive overload.	1966	1908	1728	1812
- Design secure, stealthy, energy-efficient network protocols on a miniature radio to support the networked sensors, a key element of the inter-netted Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) in providing situational awareness, and to provide enhanced communications capabilities for unattended sensor arrays, smart munitions, and robotics platforms. In FY04, designed a 2nd generation radio with efficient RF front-end and optimized network security for enhanced thru-put and energy operation; field evaluated at 3 sites. In FY05, will conduct evaluations with sensor networks integrated with miniature radios using enhanced media access control to enable collaborative sensing. In FY06, will enhance radio to enable lower power, smaller size, less cost providing for more ubiquitous military use and improved force protection/survivability. In FY07, will optimize sensor and communications integration with optimal energy utilization to extend battery life and thus increase the safety of soldiers during military operations.	430	421	390	400

Accomplishments/Planned Program A(continued)	FY 2004	FY 2005	FY 2006	FY 2007
- 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 FY04, conducted experiments with miniature sensors to validate robustness of algorithms; experimented and researched robust network control by deterring network attacks in simulated setting. In FY05, will conduct advanced network assurance experiments in a laboratory environment with a view toward increasing the security of critical military data and information. In FY06, will begin validation of advanced network assurance using at least 20 nodes in a relevant environment. In FY07, will complete validation and demonstrate prototype with access control and tactical Public Key Infrastructure (PKI) across warfighter information network to enable interoperability with sustaining base.	657	653	612	618
- In coordination with CERDEC, conduct research into techniques for automated Course of Action (COA) evaluation incorporating "reasonable-time" battlefield information and the development of COA analysis decision tools through the extension of mathematics of war-gaming, combat modeling and statistical methods to enhance the staff's planning capability to generate manifold options for the mobile commander in an actual battlefield engagement with an emphasis on complex and urban environments. In FY04, improved techniques to generate alternate COAs automatically for analysis; matured algorithms providing insights into commander's decision making process with metrics for determining key battlefield parameters affecting outcomes. In FY05, will provide the TRADOC Battle Labs with tools to conduct simulations in the field to validate the benefits of enhanced C2 capabilities. In FY06, will reduce decision cycles, improve the tempo of operations, and reduce risk through use of automated COA analysis tools. In FY07, will deliver suite of algorithms to CERDEC providing the mounted and dismounted soldier and commanders the ability to understand and absorb the impact of various plans and aid in selecting the best plan to improve survivability and lethality based upon key parameters/predictive outcomes.	886	880	860	875
Totals	3939	3862	3590	3705

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	3982	3688	3770
Current Budget (FY 2006/2007 PB)	3862	3590	3705
Total Adjustments	-120	-98	-65
Net of Program/Database Changes			
Congressional Program Reductions	-58		
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer	-62		
Adjustments to Budget Years		-98	-65

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602784A - MILITARY ENGINEERING TECHNOLOGY

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	55531	52500	47046	48188	49685	50176	50612	50987
855	TOP,IMAGE INTEL&SPACE	14480	10521	11094	11894	12231	12363	12469	12561
H71	ATMOSPHERIC INVESTIG	5874	6504	6574	6757	6788	6923	6983	7035
T40	MOB/WPNS EFF TECH	16306	17094	16370	16542	17388	17472	17623	17752
T41	MIL FACILITIES ENG TEC	4620	4854	4904	5068	5148	5199	5245	5284
T42	COLD REGIONS ENGR TECH	3921	4269	4421	4540	4649	4701	4744	4780
T45	ENERGY TEC APL MIL FAC	2635	3123	3683	3387	3481	3518	3548	3575
T48	CENTER FOR GEOSCIENCES & ATMOSPHERIC RESEARCH	1753	1727	0	0	0	0	0	0
T49	UNIVERSITY PARTNERING FOR OPERATIONAL SUPPORT	2532	2492	0	0	0	0	0	0
T52	STATIONARY POWER AND ENERGY APPLIED RESEARCH (CA)	2435	958	0	0	0	0	0	0
T53	MILITARY ENGINEERING APPLIED RESEARCH (CA)	975	958	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this applied research program element 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 will improve 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). Work in this program element is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi, and the Army Research Laboratory located at Aberdeen, Maryland.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	47152	49693	51215
Current Budget (FY 2006/2007 PB)	52500	47046	48188
Total Adjustments	5348	-2647	-3027
Net of Program/Database Changes			
Congressional Program Reductions	-682		
Congressional Rescissions			
Congressional Increases	6400		
Reprogrammings			
SBIR/STTR Transfer	-370		
Adjustments to Budget Years		-2647	-3027

Change Summary Explanation:

Four FY05 Congressional adds totaling $6400 were added to this PE.

FY05 Congressional adds with no R-2A:
($958) Distribute Transportable Synthetic Fuel Manufacturing Modules, Project T52: The purpose of this one year Congressional add is to fund research in transportable synthetic fuel manufacturing modules.
($1728) Geoscience and Atmospheric Research, Project T48: The objective of this one year Congressional add is to develop and transition technologies for enhanced operational effectiveness in Army and Air Force atmospheric science programs. No additional funding is required to complete this project.
($958) Modeling and Analysis of Response of Structures, Project T53: The purpose of this one year Congressional add is to fund research in the

modeling and analysis of response of structures. No additional funding is required to complete this project.
($2493) University Partnership for Operational Support, Project T49: The objective of this one year Congressional add is to continue research in the area of atmospheric sciences for the purpose of providing operational solutions to environmental problems as identified by Army and Air Force users. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
855 TOP,IMAGE INTEL&SPACE	14480	10521	11094	11894	12231	12363	12469	12561

A. Mission Description and Budget Item Justification: This project provides 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 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). Work in this project is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Data Generation – In FY04, tested, demonstrated and delivered capabilities to identify targets and characterize terrain, including urban terrain, using hyperspectral and Lidar data exploitation. In FY05 develop methods to generate features from multispectral imagery, soils, and collect data from wireless devices in theater; develop prototype capabilities that convert geographic information within intelligence messages or other non-structured data into geospatial data for spatial analyses. In FY06, will develop capabilities to geo-encode non-spatial sources to support planning and military decision-making process. In FY07, will develop tactical sensing capabilities to detect and geolocate chemical and biological agents, and other critical battlespace environment features.	3975	2256	1786	2555
Data Management – In FY04, developed models and other capabilities to rapidly incorporate new terrain data into a geospatial database that will improve the analysis of time-sensitive geospatial information. In FY05 develop and release tools that automate the fusion of elevation data from various sources and registration of imagery from multiple sensors. In FY06, will complete end-to-end testing of geospatial data management methods and tools and transition tools to Army systems/services. In FY07, will develop tools to correlate and integrate/fuse geospatial data from various heterogeneous sources (including tactical sensors and other sources) into a common geospatial database that supports multiple applications.	6675	4680	4699	4425

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Data Analysis – In FY04, developed terrain reasoning tools that incorporate dynamic battlespace environmental effects prediction into commander's course-of-action (COA) analysis; transitioned terrain reasoning tools to the Commercial Joint Mapping Tool Kit (CJMTK) and Maneuver Command and Control (MC2); developed initial information models to assist aviators perform air maneuver route network planning. In FY05, develop and experiment with tactical bandwidth compatible terrain reasoning tools; develop information models and algorithms to solve multi-variable helicopter air maneuver route planning based on terrain, weather, and sensor effectiveness; develop initial spatial-temporal information constructs and terrain analysis capabilities for urban tactical battlespace environment planning. In FY06, will develop prototype situation and threat analysis tools that will incorporate time-sensitive COA information for Future Force applications addressing unit of action operations; will develop algorithms to solve maneuver route planning for helicopters and unmanned aerial vehicles. In FY07, will develop urban terrain reasoning tools that incorporate the effects of natural, man-made features and human activities into urban COA planning tools.	3830	3585	4609	4914
Totals	14480	10521	11094	11894

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H71	ATMOSPHERIC INVESTIG	5874	6504	6574	6757	6788	6923	6983	7035

A. Mission Description and Budget Item Justification: The objective of this project is to perform the 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 Project Director Integrated Meteorological System (PD-IMETS), and in the future to the Program Manager, Distributed Common Ground Station-Army (DCGS-A), 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 and FCS 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 2004	FY 2005	FY 2006	FY 2007
Mature a new high resolution, short-range forecasting capability based on integrating new battlefield meteorological data sources (non-conventional meteorological sensors such as UAVs, robotic sensors, etc) into model initialization which will directly impact nowcast/very short-range forecast accuracy over the target area & provide much higher resolutions over the theater of operations. Implement a research version of an operational forecast/meteorological model that can ingest data from met satellites, UAV, and ground-based sensors. Research & verify the capability to host the model on battlefield processors, including battlefield fire support systems, to allow for autonomous generation of artillery meteorological message & production of near real time decision aids. In FY04, evaluated & modified model packages that include a micro-scale diagnostic model for very fine resolution combined with a meso-scale predictive model. Completed & evaluated a preliminary set of artillery-tailored decision aids. Modified & evaluated a research model for its ability to accept and process data from local and non-traditional sensors. Provided support to the PM TIMS for the developmental & operational test of artillery meteorological systems for fire support. In FY05, evaluate models with the most complete set(s) of modifications for insertion of meteorological data from non-traditional sources that are likely to exist on the future network-centric battlefield. Evaluate the modified research model for operation on processors that simulate those likely to be available to the network-centric future forces. In FY06, implement modifications based on field test results and complete a preliminary version of the research model that can ingest data from non-traditional sources. In FY07, implement & evaluate a combined set of atmospheric models that can produce analyses & nowcasts at very fine scales for urban & complex terrain regions and are capable of assimilating non-traditional data.	2213	2251	2399	2442

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
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 & war games, and for sensor/weapon development. Mature the Acoustic Battlefield Aid (ABFA) and tri-service Target Area Weapons Software as key acoustic & EO decision aids. Integrate distributed client applications on mobile devices for "first in" decision aids & for "over watch" of lower echelons. Devise access to weather on embedded soldier & system processors. Integrate vegetation & terrain effects and infrasonic frequencies into ABFA to support intelligence analysis. In FY04, compression techniques for acoustic & infrasonic data retrieval were implemented. Analyzed acoustic and infrasonic signatures to characterize and identify the source. Completed/evaluated a set of artillery-tailored decision aids. Integrated atmospheric propagation into models for natural, nocturnal & artificial illumination to improve characterization of urban environment effects on signatures & target acquisition. Integrated weather impacts on signatures using the Weather & Atmospheric Visualization Effects for Simulation (WAVES) model suite. In FY05, create 3D acoustic propagation model for handling dynamic atmospheric inputs & complex ground surfaces to produce high-fidelity simulated signals & realistic environmental impact for acoustic sensors. Devise optical turbulence blur/feature distortion effects models to simulate performance differences & tradeoffs in sensor optics, detector spectral responses & signal processing methods. In FY06, integrate acoustic & seismic decision aid into a library of analysis modules tailored for user applications. Integrate a polarized radiative transport module in WAVES. In FY07, integrate route planning decision aids based on effects of winds, terrain, & weather hazards on platform performance.	1758	1930	2102	2148

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Integrate high resolution boundary layer meteorological measurements with models to improve quantifying combat conditions in urban/complex terrains. Enable the continuous assimilation of real time, 3D Light Detection And Ranging (LIDAR) remotely sensed wind data into micro-scale urban wind models for near real time, 3D picture of the current atmosphere over urban/complex terrain. Devise weather satellites' data applications to improve battlefield sensing. Apply new data compression standards to demonstrate 25:1 or greater compression of 2D, 3D and 4D meteorological databases to reduce bandwidth requirements. Quantify the value added of additional battlefield surface observations & vertical profiles to improve objective analysis, short-term forecasts and decision aids. Devise/verify algorithms for optimum meteorological sensor placement. Perform detailed measurements of the urban meteorological environment for model development/verification. In FY04, completed research on laser-based techniques for aerosol detection/classification using polarization scattering for aggregate particles. In FY05, improve remote laser-based techniques for aerosol detection/classification. Investigate pattern classification techniques of background aerosols for class differentiation. Show the fusion of LIDAR urban wind measurements with a 3D urban wind model. In FY06, show urban aerosol characterization using remote sensing for identification/verification with in situ collected data. Measure, characterize & analyze meteorological data over urban/complex terrain. Investigate automation techniques for sorting aerosol particles by optical signatures to identify threat agents. In FY07, show a prototype automated MetSpaces information service with agents to collect/manage battlefield meteorological data & distribute model based products between echelons. Investigate the use of super-continuum LIDAR for remote spectral identification of chem/bio threat agents.	1903	2323	2073	2167
Totals	5874	6504	6574	6757

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T40	MOB/WPNS EFF TECH	16306	17094	16370	16542	17388	17472	17623	17752

A. Mission Description and Budget Item Justification: The objective of this project is to mature technology 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; and for rapid port enhancement. This research supports development of the Future Combat Systems (FCS) and 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 will mature technologies that will 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). Work in this project is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Force Protection - In FY04, developed guidance for rapid construction of survivability and fighting positions tailored to urban environments to increase probability of survival of personnel and critical assets in urban structures by a minimum of 30% from enhanced blast and fragmentation weapons; evaluated expedient protective concepts for PATRIOT and Joint Tactical Ground Station in support of the Program Executive Office for Air, Space and Missile Defense. In FY05, increase the number of structural types that can be rapidly assessed from 13 to 20 structural types; develop protection upgrades for a variety of forward facilities. In FY06, will deliver algorithms for assessing the effectiveness of blast/fragment protection upgrades to structures in contingency environments that will increase the resistance of structures by 90% to 200% above current minimal protection. In FY07, will develop algorithms for survivability design and assessment tools, will develop 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.	4619	5000	4899	4667
Weapons Effects and Structural Response – In FY04, completed methodology to predict blast effects on structures protected by barriers, conducted experiments measuring airblast from adjacent buildings. In FY05, develop algorithms for predicting penetration of Army weapons into multiple thin construction layers; define mechanical properties of urban construction materials; estimate lethality and collateral damage for range of urban target structures using existing weapons effects prediction methods. In FY06, will start creation of appropriate analysis algorithms to fill gaps in MOUT lethality modeling. In FY07, will finalize analytical procedures for predicting multi-threat objective projectile/target performance; will produce predictive capability for scaleable weapons effects on structures.	2145	1481	1266	1180

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Force Projection/Joint Rapid Airfield Construction - In FY04, completed characterization of unbound pavement materials and selected assessment technologies for rapid airfield construction. In FY05, complete modeling of thawing pavement foundations. In FY06, will develop integrated site selection tools. In FY07, will determine rapid repair techniques, shear-resistant stabilizers, and dust control materials for C-17 capable contingency airfields. Rapid Port Enhancement - In FY04, performed coastal throughput assessment for rapid force projection and sustainment operations for a particular theater of operation, including assessment of capabilities to meet force projection demands associated with the Army Transformation; tested database methodology for current Theater Support Vessel design capabilities and provided parameters affecting throughput for development of the Small Port Throughput Simulation Model. In FY05, integrate the Small Port Throughput Simulation Model into larger-scaled modeling systems and applications; conduct intermediate-scale experiments for the Lightweight Modular Causeway System (LMCS). In FY06, will finalize design of LMCS and complete the Small Port Throughput Simulation Model.	4672	4823	4585	3982
Maneuver Support/Gap Defeat – In FY04, identified and evaluated technologies for physically measuring critical terrain gap parameters to improve gap reconnaissance techniques. In FY05, evaluate concepts for defeating gaps less than four meters wide through simulation and analyses; determine mobility performance attributes for advanced vehicle platforms such as small unmanned ground vehicles; create hydrologic decision analysis capability for wet gaps to provide rapid in-theater maneuver assessment for the warfighter. In FY06, will integrate reconnaissance technologies for characterizing critical features of terrain gaps less than 4 meters wide and conduct evaluations of gap crossing technologies in simulated environments; will create a force response element that represents the soil/snow for any motion system operating in real time simulated environments. Future Force Breaching - In FY05, conduct experiments that define breaching effectiveness for hand-placed and standoff demolitions against structures. In FY06, will experimentally evaluate wall breaching capabilities of specific ARDEC candidate demolition devices. In FY07, will produce capability to predict the performance of hand-placed and standoff demolition devices on structures.	3100	3900	3904	2242

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Battlespace Environment Support - In FY04, created innovative common maneuver information products for entity and aggregate level maneuver networks such as Battlespace Terrain Reasoning and Awareness (BTRA) and the OneSAF Objective System (OOS) constructive, entity-level simulation; matured solutions for predicting future performance of roads, bridges, and naturally occurring static obstacles to expedite throughput assessment over enhanced maneuver networks; created logistics support models for timing, resourcing, and deconfliction over tactical routes. In FY05, mature unique scaling and adaptive algorithms between entity and aggregate level maneuver networks including procedures to correlate and modify data structures between BTRA and OOS; develop a data model schema and structure with broader community applicability for simulation to C4ISR interoperability; mature advanced throughput models for intelligent maneuver decisions including bypass options, route planning, resourcing, and management tools, determine combined effects of static and dynamic obstacles on maneuver planning tools, provide functional components to create a common integrated obstacle overlay capability; advance tactical analyses of urban terrain and population as they pertain to the spectrum of military operations. In FY06, will develop capability for transferring additional high-priority BTRA maneuver-related information products to OOS and other applications, will introduce extensions for computer-generated forces behaviors supporting training and course of action development and analysis. In FY07, will develop and refine products/procedures for interoperability; will expand scaling as required based on set of BTRA information products; will incorporate additional behaviors and related components as necessary to support training and course of action development and analysis.	1770	1890	1716	1523
Remote Assessment/Rapid Analysis – In FY07, begin to develop technologies for infrastructure reconnaissance for urban operations, for rapid target/structural characterization, and for remote battle damage assessment for fixed assets.	0	0	0	2948
Totals	16306	17094	16370	16542

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T41	MIL FACILITIES ENG TEC	4620	4854	4904	5068	5148	5199	5245	5284

A. Mission Description and Budget Item Justification: The objective of this project is to perform applied research necessary 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 forward basing. In addition, planned facility enhancements will achieve cost reduction in the Army facility life cycle process (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal), and the supporting installation operations. This work will improve the ability of installations to support forces to meet transformation goals and to enhance 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. 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 U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Facility Engineering – In FY04, completed development and recommended rehabilitation procedures for seismic upgrades to roofing diaphragms; developed innovative strategies and business practices for life cycle commissioning of facilities to support CBR protection. In FY05, complete initial beta version of model to depict CBR airborne dispersion rates in military facilities, and establish performance related requirements for building envelopes, and complete forward facility planning tools. In FY06, will complete a forward facility site selection decision aid that will enable the Unit of Employment to quickly establish forward operating locations. In FY07, will 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.	2336	3000	4904	5068
Facility Modeling and Simulation/Fort Future – In FY04, delivered to USACE and ACSIM a decision support environment that used modeling and simulation to test and validate the ability of installation infrastructure investments to meet future force deployments, training readiness, facilities and anti-terrorism requirements. In FY05, validate prediction and optimization algorithms for installation capability to support Army Installation Transformation; extend force projection algorithms to cover multiple, regional installations.	2284	1854	0	0
Totals	4620	4854	4904	5068

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T42	COLD REGIONS ENGR TECH	3921	4269	4421	4540	4649	4701	4744	4780

A. Mission Description and Budget Item Justification: This project provides 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). Work in this project is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
	3086	3409	3351	3405

Terrain State – In FY04, advanced terrain state modeling and incorporated region/area specific probability detection functions defining background clutter impact on sensor performance for Battlespace Terrain Reasoning and Awareness tactical decision aids; completed assessments for strengthening indigenous soils during thaw periods for rapid all-season construction of forward theater airfields, and extended finite element modeling of tire-terrain interactions to these materials. In FY05, develop models and tactical decision aids for incorporating weather impacts on terrain into the Future Combat Systems commander's mobility analysis and course-of-action decision tools; establish initial suite of remote site assessment, evaluation and selection decision aids for Joint Rapid Airfield Construction; mature and transition to the U.S. Army Tank Automotive Research, Development and Engineering Center vehicle simulator, high resolution 3-dimensional vehicle-terrain interaction algorithms for simulating terrain surfaces of snow, semi-frozen and thawing soils at the Ethan Allen Firing Range test track in Vermont. In FY06, will complete formulation for all-season, all-terrain, 3-dimensional soil modeling for input to ground platform and terrain mechanics simulations; will complete model parameterization for vegetation and ground surface processes for tactical terrain analysis. In FY07, will formulate new model of energy and mass exchange for exterior urban surfaces to support target surveillance and reconnaissance; will validate models of radiant temperatures of urban exterior surfaces.

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Signature Physics – In FY04, developed tactical complex terrain thermal modeling tools for urban and complex features; completed assessment of acoustic propagation in forested terrain and established a methodology for modeling propagation in complex/urban environments; initiated high-fidelity acoustic propagation simulation and dynamic acoustic vehicle signature model and established basis for developing generic performance criteria for unattended seismic ground sensor tactical decision aids in support of the Networked Sensors for the Future Force (NSfFF) program. In FY05, complete high-fidelity acoustic propagation simulation and dynamic acoustic vehicle signature model and mature algorithms to self adapt unattended ground sensors for local geologic effects in support of NSfFF; develop query and subscription based incorporation of signature physics tool set (e.g., weather induced terrain state) with the Command and Control in Complex and Urban Terrain program collaboration tools. In FY06, will complete wide area infrared targeting template based on terrain-weather phenomena for wide range of targets and backgrounds. In FY07, will formulate new approaches to multi-sensor fusion (e.g., acoustic and seismic) and optimization based on propagation phenomenology in a complex battlespace environment.	835	860	1070	1135
Totals	3921	4269	4421	4540

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T45 ENERGY TEC APL MIL FAC	2635	3123	3683	3387	3481	3518	3548	3575

A. Mission Description and Budget Item Justification: The objective of this 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, and in the theater of operations to reduce 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). Work in this project is performed by the U.S. Army Engineer Research and Development Center that is headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Energy and Utility Systems Response to Threats – In FY04, analyzed supply and demand technologies allowing for an integrated building control system that provides for a highly reliable platform for chemical and biological protection and energy efficiency. In FY05, develop indoor performance analysis tools for building mechanical systems consistent with chemical and biological protection needs, and complete initial beta version of model to depict chemical and biological water borne dispersion rates in water systems. In FY06, will validate CBR analysis tools in a controlled test facility. In FY07, will compare tool analyses to an instrumented Army facility using simulated chemical and biological agents.	1245	1943	2171	3387
Installation Modeling and Simulation/Fort Future – In FY04, matured dynamic risk models to analyze supply and demand of energy/environment distribution systems to include CBR terrorist threat scenarios for critical military facilities. In FY05, develop integrated tools for judging suitability of energy infrastructure to support power projection, readiness, threat assessment, and sustainability requirements. In FY06, will extend simulations for power, water, and fuel infrastructure analysis to forward staging areas.	1390	1180	1512	0
Totals	2635	3123	3683	3387

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
790	PERSONNEL PERFORMANCE & TRAINING TECHNOLOGY	15137	14846	15207	16006	16506	16639	16782	16906

A. Mission Description and Budget Item Justification: The objective of this project is to provide the scientific basis for personnel, training, and leader development that will ensure that the human warfighter can maximize the benefit of advances in technology, weapons, and equipment and can perform effectively in Future Force operations. The project, where feasible, also exploits opportunities to enhance Current Force capabilities. The behavioral and social science applied research conducted in this project will provide methods, techniques, and tools that will enable the Army to: select Soldiers who are predicted to perform well in future jobs and assign them to jobs that better match their skills and abilities; accelerate the development of leader critical thinking and interpersonal communication skills through virtual practice so that junior leaders are more prepared for the uncertain, rapidly changing missions they are facing today and missions that are predicted to be even more complex in the future; leverage embedded training technologies for training Command and Control (C2) in a distributed networked environment , for training dismounted squad leaders and teams to operate effectively on the battlefield with Future Force Warrior (FFW) technologies, and to conduct effective collective training, mission rehearsal, and feedback. This program leverages and coordinates with work at Simulation and Training Technology Center (STTC), Natick Soldier Center, Army Research Laboratory (ARL) and Communications Electronics Command (CECOM). 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 U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Personnel Selection and Assignment: In FY04, identified and developed predictors and measures of future enlisted Soldier job performance; validated new screening tools and developed implementation strategies for new recruiter and station commander screening tests; and developed prototype job certification measures. In FY05, develop guidelines and recommendations for a more flexible enlisted selection and classification system that can keep pace with changing job requirements; validate new certification measures to ensure Soldiers qualify on the skills necessary for effective job performance; develop a set of alternative methods or interventions that can improve enlisted attrition management. In FY06, will develop a plan to implement and evaluate interventions to improve enlisted attrition management; will initiate identification of quality indicators for evaluating Army officer performance and the correlates of officer commitment/retention; will conduct a selection-oriented analysis of the Future Combat Systems (FCS) work environment. In FY07, will implement interventions for improved attrition management and begin designs for experimentation to determine their effectiveness; will identify Soldier characteristics needed for successful performance in FCS and networked environments; will develop a preliminary model of factors that influence officer career commitment/retention and refine quality indicators for officer evaluation.	3780	3712	3802	4002

Accomplishments/Planned Program A(continued)	FY 2004	FY 2005	FY 2006	FY 2007
Training: In FY04, formulated principles for training key C2 skills (research done in collaboration with Communications Electronics Command (CECOM) and Army Research Lab (ARL) Collaborative Technology Alliance (CTA) on Advanced Decision Architectures); developed cutting edge training methods for new FFW small unit leader tasks and Tactics, Techniques, and Procedures (TTPs); and identified the roles of simulators and live aircraft within a model of simulation-intensive collective aircrew training. In FY05, develop methods for training key C2 skills for FCS Brigade Combat Team commanders and staffs; formulate principles of effective performance measurement in future environments; conduct evaluations of modified digital After Action Review (AAR) systems in terms of ability to support FCS C2 training; and assess the effectiveness of embedded/augmented/virtual reality approaches for small unit leader training(research done in collaboration with Simulation and Training Technology Center (STTC)). In FY06, will provide guidelines for FFW small unit leader cognitive skills training and demonstrate AAR feedback capabilities in wearable computers; will develop techniques to identify, describe, and measure tactical tasks for future operating environments; and will develop methods and guidelines for shifting post-exercise extrinsic feedback to real-time intrinsic feedback to improve mission rehearsal and performance. In FY07, will develop guidelines for direct communications in real-time between exercise control and AAR systems; will conduct analysis of Future Force dismounted small unit collective training requirements and identify alternative training methods; and will identify potential automated approaches for planning, preparation, training, and assessing of simulation-based collective training.	7572	7423	7603	8003

Accomplishments/Planned Program A(continued)	FY 2004	FY 2005	FY 2006	FY 2007
Leader Development: In FY04, identified components of an experiential growth model of accelerated leader development; developed techniques for small group coaching of leaders; designed multinational team leader training and developed preliminary measures of multinational team-leader skills. In FY05, develop computer-based coaching for expanding leader skills through experiential learning; develop and evaluate a prototype training system for leaders of multinational teams; develop self assessment techniques to increase leader self awareness. In FY06, will develop on-line self-appraisal measures and feedback techniques for enhanced self development; will develop new leadership growth model; will identify skills (cognitive, interpersonal), knowledge and attitudes that leaders need to perform under conditions of stress. In FY07, will evaluate on-line self-assessment tools for improved leadership growth and development; will validate effectiveness of protocols for collecting and analyzing leadership vignettes from Soldiers in the field; and will design instruments for assessing the leader skills and attitudes needed for effective performance in high-stress operations.	3785	3711	3802	4001
Totals	15137	14846	15207	16006

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	15322	15622	16288
Current Budget (FY 2006/2007 PB)	14846	15207	16006
Total Adjustments	-476	-415	-282
Net of Program/Database Changes			
Congressional Program Reductions	-222		
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer	-254		
Adjustments to Budget Years		-415	-282

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602786A - LOGISTICS TECHNOLOGY

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		49071	54051	21707	24778	21777	19551	19713	19848
283	AIRDROP ADV TECH	4714	2484	2200	2265	2314	2336	2357	2373
C60	AC60	3958	4105	1654	3651	0	0	0	0
E01	WARFIGHTER TECHNOLOGY INITIATIVES (CA)	18602	33400	0	0	0	0	0	0
H98	CLOTHING & EQUIPM TECH	17022	9041	12970	13804	14268	11964	12061	12141
H99	JOINT SERVICE COMBAT FEEDING TECHNOLOGY	4775	5021	4883	5058	5195	5251	5295	5334

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 larger 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 encapsulated cooling to the Soldier in extremely hot environments; and significantly lighten the soldier's 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 U.S. Army Natick Soldier Center, Natick, MA.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	21131	22371	25215
Current Budget (FY 2006/2007 PB)	54051	21707	24778
Total Adjustments	32920	-664	-437
Net of Program/Database Changes			
Congressional Program Reductions	-685		
Congressional Rescissions			
Congressional Increases	34840		
Reprogrammings			
SBIR/STTR Transfer	-1235		
Adjustments to Budget Years		-664	-437

Change Summary Explanation:

Fifteen FY05 Congressional adds totaling $34840 were added to this PE.

FY05 Congressional Adds in Project E01 with no R2-A:
($1439) Advanced Antimicrobial Technology: The purpose of this one year Congressional add is to complete evaluation of advanced antimicrobial technologies for clothing and individual equipment for the soldier. No additional funding is required to complete this project.

($1630) Aviation Inflatable Maintenance Shelter (AIMS) Test and Evaluation: The purpose of this one-year Congressional add is to fabricate and evaluate large airbeam maintenance shelters. No additional funding is required to complete this project.

($959) Field Evaluation and Manufacturing Improvements on Flexible Monolithically Integrated Solar Panels: The purpose of this one-year Congressional add is to improve manufacturing processes for flexible solar panel tech for field shelters. No additional funding is required to complete this project.

($2148) Flexible Monolithically Integrated Solar Panels on a Polymer Substrate: The purpose of this one-year Congressional add is to research advanced flexible solar panel technology for field shelters. No additional funding is required to complete this project.

($3117) Improved Shelf-Life in Fresh Fruits and Vegetables: The purpose of this one-year Congressional add is to research non-genetically modified varieties of produce using advanced molecular biology techniques for shelf life extension. No additional funding is required to complete this project.

($2397) Integrated, Unbreakable, Flexible Visible and Infrared Lighting Surfaces: The purpose of this one-year Congressional add is to investigate and evaluate textile-based luminescent panels for battlefield shelters. No additional funding is required to complete this project.

($3739) NBC Integrated Protection Membrane-Shelters: The purpose of this one year Congressional add is to research breathable, non-powered chemical/biological shelter technology. No additional funding is required to complete this project.

($1199) Next Generation Chemical/Biological Agent Protection: The purpose of this one-year Congressional add is to investigate materials for improved chemical and biological agent protection. No additional funding is required to complete this project.

($2397) Self-Decontaminating Selectively Permeable Membranes: The purpose of this one-year Congressional add is to complete research chemical/biological decontaminating membrane materials. No additional funding is required to complete this project.

($959) Smart Apparel for Warriors: The purpose of this one-year Congressional add is to research textile materials incorporating sensing and/or response mechanisms. No additional funding is required to complete this project.

($959) Soldier Systems Center: The purpose of this one year Congressional add is to complete evaluation of large-scale production processing of combat ration components using advanced thermal and non-thermal sterilization technologies. No additional funding is required to complete this project.

($959) Special Operations Precision Airdrop Technology: The purpose of this one-year Congressional add is to research into new methods of parachute control. No additional funding is required to complete this project.

($5084) Supplemental Body Armor Research: The purpose of this one-year Congressional add is to investigate improved production processes for high performance fiber. No additional funding is required to complete this project.

($4315) US Army Center of Excellence: Advanced Structures and Composites in Construction: The purpose of this one-year Congressional add is to

develop advanced modeling and empirical evaluation capability for flexible composites. No additional funding is required to complete this project.

($2110) Warfighter Technology: The purpose of this one-year Congressional add is research technologies with potential to improve the survivability of the soldier. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
283 AIRDROP ADV TECH	4714	2484	2200	2265	2314	2336	2357	2373

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 the 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 (ATAPS). 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 2004	FY 2005	FY 2006	FY 2007
Advanced Air Cargo Delivery - In FY04, completed the airdrop system modeling tool and refinement; investigated material alternatives for Precision Airdrop - Medium (30,000 lbs); identified preferred concepts and conducted component modeling. In FY05, complete airdrop system model validation and transition high-fidelity computer modeling tool to Program Manager Force Sustainment Systems and industry; and evaluate sub-scale concept models for Precision Airdrop - Medium.	1855	2484	0	0
Parachutist Proximity Detection Technology - In FY04, completed evaluation of Radio Frequency (RF) technology as a proximity detection system in order to determine the most reliable frequencies and or coding techniques to minimize the effects of interference due to a tumbling and unstable jumper.	500	0	0	0
Personnel Parachute Technology - In FY06, will investigate soft landing and parachute opening technologies aligned with ATAPS Preplanned Product Improvement needs. In FY07, will complete investigation of soft landing and parachute opening technologies aligned with ATAPS program and transition results to PM Clothing & Individual Equipment (PM-CIE).	0	0	1200	1065

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Parachutist Airdrop Systems Modeling and other concept studies – In FY06, will use High Performance Computing modeling to investigate fully open parachutist control behavior, rate of descent issues, and parachute opening performance; and will model the biomechanics of jumper exit and landing. In FY07, will complete investigation of fully open parachutist control behavior, rate of descent issues, and parachute opening performance; will complete modeling of the biomechanics of jumper exit and landing; and will transition results to PM-CIE ATAPS program. Will conduct concept study for very large, gliding decelerators for their potential use with payloads up to 20 tons.	0	0	1000	1200
Standoff Precision Aerial Delivery System (PADS)- In FY04, this one-year Congressional add improved PADS capabilities through multi-channel wind sensors, advanced wireless download capabilities and raising performance up to 35K ft Mean Sea Level (MSL). No additional funding is required to complete this effort.	2359	0	0	0
Totals	4714	2484	2200	2265

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H98	CLOTHING & EQUIPM TECH	17022	9041	12970	13804	14268	11964	12061	12141

A. Mission Description and Budget Item Justification: This project researches and investigates technologies to improve Soldier survivability and performance. Research focuses on: ways to significantly lighten the Soldier's load; lightweight materials for personal survivability (e.g., improved ballistic, flame, and directed energy protection, enhanced signature management); and modeling and analysis tools for optimizing Soldier system clothing and equipment. The goal of the ballistic protection work is to research and apply advances in materials technology to improve the protection and performance of warrior armor systems against conventional and emerging ballistic threats. The objective of the novel blast protection effort is to characterize blast profiles, determine the hazard, and demonstrate improved protectin concepts. The Lightweight Soldier effort employed virtual prototyping tools to integrate warrior "system-of-systems" concepts on the human to increase the fightability of dismounted warrior systems. The goal of warrior systems modeling and simulation is to build essential analytic tools needed to assess the combat worth of next generation warrior systems ranging from the current Soldier to the Future Force Unit of Action Soldier. 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 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. This project leverages work performed by the Institute for Soldier Nanotechnologies supported by PE0601104A (University and Industry Research Centers) and PE0602105A (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 U.S. Army Natick Soldier Center, Natick, MA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Ballistic Protection for the Individual Warrior – In FY04, established technology with 25% reduced areal density over FY00 baseline against tungsten-carbide core projectiles (0.30 caliber or less); established transparent armor technology for face protection with a 30% reduced areal density for fragmentation protection that will also provide handgun protection; evaluated initial set of composite material systems for novel integrated armor and load carriage components of the Future Force Warrior (FFW) system architecture that enhance Soldier mobility, thermal balance, protection, and performance; and established enhanced assessment model to evaluate advanced fibers for potential ballistic protective materials and selected those that have potential to achieve weight reductions. In FY05, enhance fiber mechanical properties through processing/post-processing techniques and evaluate ability to meet performance requirements; begin research on material system(s) architecture incorporating advanced fibers into flexible materials and composite technology. In FY06, will mature material(s) system(s) architecture for both flexible and composite technology to include resins system, adhesion modifiers, and fiber architecture. In FY07, will demonstrate technology with a 30% reduction in weight (over the level achieved in FY03) with equivalent fragmentation protection in flexible and composite configurations; and will transition composite technologies to ballistic protective garments to reduce weight and/or increase multiple-hit capability.	4645	2930	2500	1500
Novel Blast Protection – In FY04, established fundamental theories for material behavior for personnel blast protection and constructed a force-based test device for testing protective material system concepts. In FY05, define and develop initial protective material system concepts for fielded Interceptor Vest (“add-on” blast protection) and Future Force Warrior. Conduct evaluations on material system concept(s). In FY06, will validate test device for blast protective materials, refine concept for Interceptor Vest and transfer technology to PM-Clothing & Individual Equipment. In FY07, will develop an integrated concept for blast protection of future warrior, validate performance and transition to Land Warrior development program.	1000	2930	2500	1700

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Lightweight Soldier Materials & Virtual Prototyping Tools – In FY04, completed documentation of performance of nanotechnology-based system components and enhancements of virtual prototyping tools; accelerated and applied virtual prototyping enhancements to FFW technology components in two of four planned FFW component design cycles; completed fatigue detection algorithms to better predict fatigue for dismounted soldiers; completed methodologies for data extraction/transfer from Data Access and Retrieval Tool (DART), a data repository being developed for modelers and analysts throughout DoD; and accelerated technology development in advanced materials areas including ventilation/cooling, electro-textiles, and novel uniform materials for transition to the FFW program in FY05.	7450	0	0	0
Warrior Systems Modeling Technology – In FY04, completed development of a small unit, force-on-force, High Level Architecture compliant model to assess the combat effectiveness of warrior components and systems. In FY05, establish next generation intelligent agent capabilities to assess information inputs and decision-making at the small unit level. In FY06, will develop small unit intelligent agent decision-making capability for urban building interior operations. In FY07, will model the effects of sensor information used by the networked warrior. Will provide initial small unit battle command module to evaluate impact of information transfer on small unit performance.	2077	2059	1830	2210
Nanocomposites/fibers and Electrotextiles for Warrior Systems - In FY04, matured technology towards lightweight and conformal prototype photovoltaic (PV) battery rechargers that could be either directly integrated into a soldier “mule” or carried by the individual soldier for renewable battery recharging for FFW systems. In FY05, conduct research to create PV fibers and identify most promising near-term conductive textile-based technologies; continue investigating technology for prototype portable PV mats and PV integrated shelters to recharge batteries used to power soldier-borne items. In FY06, will complete technology evaluation of PV battery recharger and transition to PEO Soldier for current forces and to FFW; and will explore power generation and electrical conductivity in unique fiber-based compositions. In FY07, will investigate and optimize new power generating and electrically conductive textile-based compositions compatible with warrior systems.	1850	1122	1500	2000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Technologies to Enhance Warrior System Performance - In FY06, will research and evaluate emerging materials/technologies for the individual soldier that have the potential to improve warrior performance, such as, microclimate conditioning (MCC) and "smart" load carriage systems; and will apply new analytical tools to design and simulate load carriage gear for a "smart" load carriage suspension system designed to automatically adjust the backpack's position, orientation, and suspension characteristics. In FY07, will research and evaluate the potential of textile-embedded, miniaturized bio-sensors to provide highly sensitive detection of bio-warfare agents, munitions and environmental hazards; and will further research and mature MCC and "smart" load carriage technologies.	0	0	1640	2394
Tunable (Frequency Agile) Laser Eye Protection - In FY06, will combine nonlinear dyes with nanostructured arrays and examine the optical limiting characteristics of the technology for tunable-laser eye protection. In FY07, will investigate materials with potential to maximize light transmission through soldier protective eyewear to provide adequate sight for the soldier, while minimizing activation response time of the materials used to block the tunable laser light.	0	0	3000	4000
Totals	17022	9041	12970	13804

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H99	JOINT SERVICE COMBAT FEEDING TECHNOLOGY	4775	5021	4883	5058	5195	5251	5295	5334

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% (i.e., weight, cube, fuel and water) and labor requirements by 50%, 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; 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; reduce replenishment demand by extending shelf-life, permitting more extensive prepositioning of stocks, while maintaining initial quality; and 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 US Army Natick Soldier Center, Natick, MA, and this project has collaborative efforts with the U.S. Army Research Institute for Environmental Medicine.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Equipment and Energy Technologies – In FY04, researched Field Feeding and Advanced Sustainment Technologies including central heat, cogeneration and greywater recycling to achieve logistical reductions; designed, fabricated and tested a prototype, lightweight, cost-effective thermoelectric water heater chiller for Future Combat Systems crew sustainment that provides the benefit of chilled water to vehicle crews; improved the process to coat commercial cookware with quasicrystals to increase the wear resistance and non-stick qualities; investigated flameless catalytic combustion of JP8 fuel; and developed an alkaline fuel cell concept that converts hydrogen (extracted from the Meal Ready to Eat flameless ration heaters in a controlled reaction) to electricity. In FY05, research technology for individual beverage chiller and water heaters for the future Soldier; will test and evaluate quasicrystalline coating technology on commercial cookware; explore self-powered and solar-powered refrigerated container technology for the Battlefield Kitchen; and evaluate and transition an alkaline fuel cell concept to control hydrogen emissions for group ration chemical heaters. In FY06, will integrate and test water chiller subsystems for soldier hydration; will complete integration of thermoelectric modules and evaluation of self-powered tray ration heater. In FY07, will complete evaluation of JP8 fueled flameless catalytic sheet materials and integrate into heater system for use with group rations; and will design and fabricate subsystems for waste to energy conversion.	2069	2277	2207	2328

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Ration Preservation & Stabilization, Revolutionary Packaging & Food Safety Technologies - In FY04, researched surface scanning technologies; increased sensitivity of food probes to enhance antibody based pathogen sensor by 30-fold; incorporated research on pathogen resistant technologies, i.e. probiotics, into ration components and evaluated viability; selected cost-effective nanotechnology-based films/packaging with optimum barrier properties; and investigated tamper evident (TE) packaging technologies at ISO-container, pallet and case level to insure security of combat rations. In FY05, research pathogen probe technology and transition to diagnostics platforms; research self-hydrating membrane pouch forward osmosis technology for safe/effective re-hydration of dried beverages/rations by non-potable water sources for the future warrior; investigate Radio Frequency Identification (RFID) technologies applicable to ration logistics, integrate into TE concept, and evaluate performance; and investigate technology to predict combat ration quality via RFID. In FY06, will tailor food sampling extraction procedures using immunoassays; will investigate electrospun arrays for capture from complex matrices and validate array technologies; and will evaluate self-hydrating pouch forward osmosis technology using various osmotic acccelerators and packaging materiel and make downselection. In FY07, will continue modification and evaluation of food sampling procedures used for biosensor systems to improve their accuracy and sensitivity to pathogenic organisms.	1663	1861	1823	1855
Technologies for Nutrients and Novel Delivery Systems – In FY04, investigated and integrated extrusion, protein encapsulation, dehydration, and combinations of technologies to provide novel nutrient delivery for ration components and enhanced performance. In FY05, investigate performance enhancing ration component technology such as gels, calorie-dense savory meat and vegetable bars, rehydratable bars, beverages and encapsulated micronutrients to enhance mobility and reduce weight and volume, and investigate oral mucosal (buccal) absorption; and research novel delivery systems. In FY06, will develop methods for buccal delivery of nutrients. In FY07, will validate buccal delivery systems and optimize nutrient delivery/absorption; will verify/evaluate percent loss of performance enhancers in ration over time and select enhancers requiring protection; and will initiate design of a system to provide continuous hydration/sustainment in an encapsulated/hazardous environment.	1043	883	853	875
Totals	4775	5021	4883	5058

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602787A - MEDICAL TECHNOLOGY

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	174622	183102	74694	74804	74821	72654	73480	74228
841	COMPUTER-ASST MINIMALLY INVASIVE SURGERY	1363	0	0	0	0	0	0	0
845	BONE DISEASE RESEARCH PROGRAM	0	958	0	0	0	0	0	0
863	BTLFLD SURGICAL REPLAC	2922	3835	0	0	0	0	0	0
865	CENTER FOR MILITARY BIOMATERIALS RESEARCH	1461	2397	0	0	0	0	0	0
866	CLINICAL TRIAL PLEZOELECTRIC DRY POWDER INHALATION	0	3835	0	0	0	0	0	0
867	DIAGNOSTICS IN TRAUMATIC BRAIN INJURY BLOOD BASED	975	2876	0	0	0	0	0	0
869	T-MED/ADVANCED TECHNOLOGY	3189	2992	2837	2960	3096	3139	3176	3208
870	DOD MED DEF AG INF DIS	13323	13769	14958	14781	15088	15373	15526	15659
873	HIV EXPLORATORY RSCH	10842	9532	10971	11313	11555	11424	11523	11608
874	CBT CASUALTY CARE TECH	8782	7613	15625	13599	11997	9141	9220	9287
878	HLTH HAZ MIL MATERIEL	11419	10779	12738	13753	14337	14546	14731	14900
879	MED FACT ENH SOLD EFF	8868	9736	9821	9940	10158	10270	10369	10454
953	DISASTER RELIEF & EMERGENCY MEDICAL SVC (DREAMS)	10713	10546	0	0	0	0	0	0
968	SYNCH BASED HI ENERGY RADIATION BEAM CANCER DETECT	22157	8148	0	0	0	0	0	0
96A	EMERGENCY HYPOTHERMIA	2239	0	0	0	0	0	0	0
96C	DIGITAL IMAGING AND CATHERIZATION EQUIPMENT	975	0	0	0	0	0	0	0
96E	HEMORRHAGE CONTROL DRESSING	2922	3356	0	0	0	0	0	0
96F	PORTABLE BIOCHIP ANALYSIS SYSTEM	0	958	0	0	0	0	0	0
96I	REMOTE ACOUSTIC HEMOSTASIS	3408	0	0	0	0	0	0	0
FH2	FORCE HEALTH PROTECTION - APPLIED RESEARCH	0	0	7744	8458	8590	8761	8935	9112

MA2	DIABETES PROJECT	6575	5752	0	0	0	0	0	0
MA3	MEDICAL AREA NETWORK FOR VIRTUAL TECHNOLOGY	5746	4889	0	0	0	0	0	0
MA5	CENTER FOR INTERNATIONAL REHABILITATION	3408	4793	0	0	0	0	0	0
MA6	DERMAL PHASE METER	1169	958	0	0	0	0	0	0
MA8	MONOCLONAL ANTIBODY BASED TECHNOLOGY	1461	0	0	0	0	0	0	0
NA7	ADVANCED SURGICAL NAVIGATION (CA)	1753	0	0	0	0	0	0	0
NA8	IMPROVING SOLDIER PERFORMANCE (CA)	2338	1727	0	0	0	0	0	0
NA9	BEHAVIORAL GENOMICS (CA)	1948	0	0	0	0	0	0	0
OA1	BIO-DEFENSE GENE KNOCKOUT TECHNOLOGY (CA)	2045	0	0	0	0	0	0	0
OA2	BIOMEDICAL ENG TECH AND ADV MATERIALS (CA)	975	0	0	0	0	0	0	0
OA3	CENTER FOR ADV SURGICAL & INTERVENTIONAL TECH (CA)	2045	958	0	0	0	0	0	0
OA4	CHRONIC MULTI-SYMPTOM ILLNESSES (CA)	4870	0	0	0	0	0	0	0
OA5	COMPUTATION PROTEOMICS (CA)	2922	2492	0	0	0	0	0	0
OA6	CONJUGATE VACCINES TO PREVENT SHIGELLOSIS (CA)	1363	0	0	0	0	0	0	0
OA7	ELGEN GENE DELIVERY TECHNOLOGY (CA)	975	958	0	0	0	0	0	0
OA8	ENHANCED RES IN TRAUMA PREVENTION/TREATMENT/REHAB	1461	1917	0	0	0	0	0	0
OA9	GENETIC ACUTE ENHANCED BIOWARFARE THERAPY PROG (CA	975	0	0	0	0	0	0	0
PA1	HEMOGLOBIN BLOOD OXYGEN CARRIER (CA)	975	0	0	0	0	0	0	0
PA2	LARGE-SCALE/POLYCLONAL/HUMAN ANTIBODY PRODUCTION	2922	0	0	0	0	0	0	0

PA4	WOUND HEALING PROJECT (CA)	3020	0	0	0	0	0	0	0
PA5	NANOFABRICATED BIOARTIFICIAL KIDNEY (CA)	2338	1869	0	0	0	0	0	0
PA6	NATIONAL TISSUE ENGINEERING RESEARCH (CA)	975	0	0	0	0	0	0	0
PA7	NON-INVASIVE MEDICAL SENSORS (CA)	1461	958	0	0	0	0	0	0
PA8	NOVEL GROWTH FACTOR DELIVERY TECHNOLOGY (CA)	975	0	0	0	0	0	0	0
PA9	PROSTHETIC DEVICE CLIN EVAL AT WRAIR AMPUTEE CTR	2435	0	0	0	0	0	0	0
RA1	SLEEP DEPRIVATION RESEARCH AT WRAMC (CA)	1461	3356	0	0	0	0	0	0
RA2	TARGETED NANOTHERAPEUTICS FOR CANCER (CA)	975	958	0	0	0	0	0	0
RA3	THERAPEUTIC VACCINES FOR BIOLOGICAL THREAT (CA)	975	0	0	0	0	0	0	0
RA4	TRANSPORTABLE PATHOGEN REDUCT AND BLOOD SAFETY SYS	1948	1917	0	0	0	0	0	0
RA5	USAMRIID ANTHRAX RESEARCH (CA)	2435	2156	0	0	0	0	0	0
RA6	VERSA HSDI (CA)	4140	4122	0	0	0	0	0	0
TA1	AUTO MEDICAL EMERGENCY INTRAVASCULAR ACCESS (CA)	0	958	0	0	0	0	0	0
TA2	ANTI-MICROBIAL COATINGS FOR MEDICAL DEVICES (CA)	0	1343	0	0	0	0	0	0
TA3	BIOACTIVE PRODUCTS PROGRAM FOR BREAST CANCER (CA)	0	958	0	0	0	0	0	0
TA4	HEALTH EFFECTS OF IONIZING RADIATION (CA)	0	958	0	0	0	0	0	0
TA5	CHRONIC WOUNDS (NON-HEALING) RESEARCH (CA)	0	958	0	0	0	0	0	0
TA6	COLLABORATIVE PROGRAM IN REHAB & ENGINEER RSH (CA)	0	958	0	0	0	0	0	0

TA7	COMBAT CASUALTY CARE FOR BATTLEFIELD WOUNDS (CA)	0	2685	0	0	0	0	0	0
TA8	COMPREHENSIVE BIOACTIVE PROD PRG FOR BREAST CANCER	0	958	0	0	0	0	0	0
TA9	COMPREHENSIVE REPRODUCTIVE SYS CARE PROGRAM (CA)	0	11408	0	0	0	0	0	0
UA1	GYNECOLOGICAL CANCER CENTER (CA)	0	2013	0	0	0	0	0	0
UA2	HIGH-SPEED MEMS ELECTROMAGNETIC CELL SORTER (CA)	0	1438	0	0	0	0	0	0
UA3	MATERNAL-FETAL HEALTH INFORMATICS & OUTREACH PRGM	0	958	0	0	0	0	0	0
UA4	INTEGRATIVE CARDIAC HEALTH PROGRAM (CA)	0	4889	0	0	0	0	0	0
UA5	NEUTRON THERAPY (CA)	0	863	0	0	0	0	0	0
UA6	PREDICTIVE TOOLS FOR PTSD (CA)	0	958	0	0	0	0	0	0
UA7	PREVENTIVE MEDICINE RESEARCH INSTITUTE (CA)	0	1438	0	0	0	0	0	0
UA8	PROTEIN HYDROGEL (CA)	0	958	0	0	0	0	0	0
UA9	MEDICAL SKILLS READINESS TRNG FOR RESERVISTS (CA)	0	1438	0	0	0	0	0	0
VA1	SHOCK TRAUMA RESEARCH (CA)	0	2013	0	0	0	0	0	0
VA2	SPINAL MUSCULAR ATROPHY RESEARCH PROGRAM (CA)	0	2156	0	0	0	0	0	0
VA3	VETERINARY MANPOWER DEVELOPMENT (CA)	0	288	0	0	0	0	0	0
X05	MOLECULAR GENETICS & MUSCULOSKELETAL RESEARCH(CA)	0	11398	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element (PE) supports focused research for healthy, medically protected soldiers and funds research consistent with the Medical, Survivability, and Future Warrior technology areas of the Future Force, and assures

compliance with Food and Drug Administration regulatory requirements for licensure of drugs, vaccines, and medical devices. The primary goal of medical research and development is to sustain medical technology to effectively protect and improve the survivability of U.S. forces in a variety of settings including, but not limited to: conventional/asymmetric battlefields, areas of low-intensity conflict, and military operations other than war.

This program element funds applied research in the following areas: Militarily-Relevant Infectious Diseases including HIV, Combat Casualty Care, and Military Operational Medicine that includes exposure to hazardous military materiels, medical factors to enhance soldier effectiveness, telemedicine, and force health protection.

Infectious Diseases: Focuses applied research on medical protection against naturally occurring diseases of military importance. Methods are identified and matured for infectious disease prevention and treatment including candidate vaccines, prophylactic intervention, therapeutic drugs, and control of disease-carrying insect vectors. HIV Exploratory Research focuses applied research on diagnostics, surveillance, epidemiology, and identification of candidate vaccines for prevention and treatment of HIV subtypes found outside the U.S., which are problematic in military deployments. Main efforts include preclinical development of candidate vaccines, improved diagnosis, and improved prognostic assessment and disease management.

Combat Casualty Care: Focuses applied research for the care of trauma and burns due to battlefield injuries. Drugs, biologics, and diagnostics for resuscitation and life support are identified and evaluated, as well as, trauma care systems for forward medic and surgeon use. It also includes Combat Dentistry research with a focus on prevention of cavities and dental disease and combat maxillofacial (face/neck) injuries on the battlefield.

Military Operational Medicine (MOM): Focuses on biomedical solutions that protect soldiers and enhance their performance in the face of multiple stressors in operational and training environments. Research examines methods such as soft body armor and biomonitors to protect soldiers from injuries resulting from exposure to hazardous environments and materiels. Prevention of health and performance degradation in military environments is another important objective of MOM research. This research 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. Additionally, findings from research and treatment of Gulf War Illness are used to better understand military health issues to protect Service members against health threats in military deployments.

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, 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 for infectious disease research, the Naval Medical Research Center, Silver Springs, MD.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	60877	69782	67732
Current Budget (FY 2006/2007 PB)	183102	74694	74804
Total Adjustments	122225	4912	7072
Net of Program/Database Changes			
Congressional Program Reductions	-7465		
Congressional Rescissions	-143		
Congressional Increases	133850		
Reprogrammings			
SBIR/STTR Transfer	-4017		
Adjustments to Budget Years		4912	7072

Change Summary Explanation:
Funding - FY 2006/2007: Funds realigned from PE 0601105A to new project FH2 for proper execution of Force Health Protection Program in accordance with DoD Financial Management Regulation Budget Activity definitions (FY 06 +7744/FY 07 +8294).
Also funds were realigned to higher priority requirements (FY 06 -1055/FY 07 -280).

Forty-Seven FY05 Congressional adds totaling $133850 were added to this PE. These one year Congressional adds are listed individually as project lines in this R-2 Exhibit, and the amounts shown correspond to the amounts of the Congressional adds. No additional funds are required to complete these projects.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
869	T-MED/ADVANCED TECHNOLOGY	3189	2992	2837	2960	3096	3139	3176	3208

A. Mission Description and Budget Item Justification: This project supports focused research for the soldier contributing to casualty avoidance, casualty detection, and evacuation and treatment of casualties through application of physiological status monitoring technologies (biophysical and biochemical sensors and fusion) as outlined in the Medical and Future Force Technology Areas. Research efforts focus on developing a wearable, integrated system to determine soldier physiological status. Work is performed in conjunction with the Natick Soldier Center. This includes developing the ability to quickly and accurately determine when a soldier is minimally impaired but still capable of functioning. Work will also focus on identification and initial development of parallel and supporting technologies and systems, including medical informatics, medical artificial intelligence, and data mining tools. Work is performed in coordination with Natick Soldier Center. 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, Silver Spring, MD; U.S. Army Research Institute of Environmental Medicine, Natick, MA; and the U.S. Army Institute of Surgical Research, Fort Sam Houston, TX.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
High Altitude Performance/Life Sign Monitoring - In FY04, determined that carbohydrate supplements ingested during physical activity in high altitude environments enhanced performance outcomes, enabling nonacclimatized soldiers rapidly deployed to high altitude environments to sustain optimal performance. An initial user-acceptable suite was selected to include Life Signs Detection and Ballistic Impact Detection systems with heat strain and sleep status monitoring capability to support key capabilities of Future Force Warrior (FFW)/Land Warrior Systems. In FY05, demonstrate ability to noninvasively monitor alertness in real-time operational settings, measure blood pressure, and incorporate this information into remote triage algorithm for FFW medic, complete human prospective trials of a fieldable acoustic collapsed lung detector; begin investigation of markers for the onset of cardiovascular collapse and algorithms to predict onset of shock. In FY06, will complete integration of the sensor suite and algorithms with the Personal Area Network and complete integration of the initial capability with FFW Advanced Technology Demonstration; conduct evaluation of relationships among variables that signal cardiovascular collapse and indicate a need to apply a Life Saving Intervention. In FY07, will complete analysis of data to refine algorithms for prediction of cardiovascular collapse.	3189	2992	2837	2960
Totals	3189	2992	2837	2960

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
870	DOD MED DEF AG INF DIS	13323	13769	14958	14781	15088	15373	15526	15659

A. Mission Description and Budget Item Justification: This project researches and investigates medical countermeasures to naturally occurring infectious diseases, which pose a significant threat to the operational effectiveness of forces deployed outside the United States. Countermeasures will 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 the parasitic disease 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). Research also explores improved materiel to control arthropod (insects, ticks, etc.) disease vectors to reduce incidence of these diseases and addresses a variety of other threats to mobilizing forces, including meningitis, viral encephalitis, scrub typhus, and hemorrhagic fevers. Improved diagnostic capabilities are pursued to enable rapid battlefield identification and treatment or management of militarily important diseases for which there is no current method of protection. Goals include developing DNA (gene-based) vaccines; incorporating new technologies to enhance effectiveness, safety, and duration of vaccines; integrating cutting-edge genomic and proteomic (protein-based) technologies into vaccine and drug discovery; developing broad spectrum vaccines that can protect against multiple disease strains and drugs to prevent or treat malaria. Work is managed by the U.S. Army Medical Research and Materiel Command. The Army is the lead service for infectious disease research. This project 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 in this project is performed by the Walter Reed Army Institute of Research, Silver Spring, MD and its overseas laboratories; U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; and the Naval Medical Research Center, Silver Spring, MD and its overseas laboratories.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Malaria Vaccines - In FY04, produced malaria parasites for use in clinical challenge studies and test development; generated protein and virus-based vaccines against malaria; conducted preclinical safety and protection studies of these vaccines. In FY05, develop and assess additional/improved vaccine antigens and delivery systems (including recombinant proteins, adjuvants, nucleic acids, recombinant viruses, administration, schedule, and doses) that induce protective immune responses. Continue preclinical testing of DNA and protein vaccine candidates for inclusion into a multicomponent malaria vaccine. In FY06, will begin to down-select best vaccine delivery strategy and antigen selection for inclusion into a multicomponent vaccine. In FY07, will improve the current clinical efficacy of lead vaccine candidates by using improved antigen and adjuvant combinations, and assess new vaccine delivery methods for potential enhancement of best vaccine candidates.	2397	2830	2670	2700
Antidiarrheal Vaccines - In FY04, refined surrogate assays to measure protection by vaccines and develop better animal models for assessing efficacy of vaccines; conducted preclinical testing of candidate antidiarrheal vaccines to support Investigational New Drug (IND) applications to the U.S. Food and Drug Administration (FDA) established process for generating candidate ETEC vaccine proteins for preclinical testing. In FY05, conduct preclinical testing of most advanced candidate vaccines; establish an animal model for use in preclinical testing of ETEC vaccines. In FY06, will complete preclinical testing of selected candidate vaccines; assess more effective delivery methods such as biological adjuvant for vaccines against diarrheal pathogens; assess non-vaccine approaches to protect against diarrhea such as oral immunoglobulin (animal protein with known antibody activity) supplementation. In FY07, will assess a combined vaccine approach for a broad spectrum anti-diarrheal vaccine.	2425	3267	2391	1948
Insect Control - In FY04, performed final evaluation of selected repellent with human volunteers, compared effectiveness in human trials to other available repellents, to down-select to a highly effective new non-DEET repellent. In FY05, complete testing of a dengue vector control system. In FY06, will enhance traditional identification aids for mosquitoes of medical importance. In FY07, will develop field expedient vector-based pathogen detection kits and assays for use in the field.	960	687	725	1526

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Scrub Typhus Vaccine and Infectious Disease Diagnostics - In FY04, completed construction of a multistrain vaccine and tested for safety and protection in animal studies; identified infectious disease diagnostic components compatible for use with Joint Biological Agent Identification and Diagnosis System. In FY05, start preclinical testing of scrub typhus vaccine to justify FDA Phase 1 clinical trials of candidate vaccine; develop approaches to supplement infectious disease diagnostics. In FY06, will evaluate multistrain scrub typhus vaccine candidates in a heterologous (made up of tissue not normal to the part) challenge mouse model; complete initial development of a new diagnostic for dengue virus or other threat. In FY07, will evaluate selected vaccine candidates for safety and immunogenicity in preclinical studies; provide an additional diagnostic reagent (based on reaction it causes is used for analysis and synthesis) set for final development.	1347	1464	2293	2012
Vaccines against Dengue Fever, Meningitis and Hemorrhagic Fevers - In FY04, selected the most promising new dengue vaccines for clinical trials and improved as needed; and performed preclinical testing of a new component of a multistrain meningitis vaccine. In FY05, complete and improve construction of the second hantavirus vaccine component to provide complete protection against hemorrhagic fevers with renal syndrome. In FY06, will test new component for an improved meningitis vaccine; evaluate alternative methods (DNA, RNA, inactivated, designed mutant, vectored, replicon (replicating DNA), and/or new adjuvants (substance that enhances reaction of body)) for making second-generation dengue vaccines. In FY07, will conduct preclinical testing of improved dengue and group B meningitis vaccines.	2037	1848	3169	3227
Malaria Drug Candidates - In FY04, selected best drug candidates for preclinical and clinical studies using a systematic, streamlined approach for evaluation and optimization of new chemical entities. In FY05, continue to test new lead compounds identified in discovery via target-directed functional screens coupled with rational drug design technologies. In FY06, will continue to test best lead compound and identify new candidate drug classes coming from drug discovery program via target-directed functional screens coupled with rational drug design technologies. In FY07, will conduct in vivo testing of putative antimalarial drugs in a mouse malaria sporozoite challenge model; perform preclinical studies of new drug candidates; provide support for clinical trials of Artesunate, a promising new malaria drug.	4157	3673	3710	3368
Totals	13323	13769	14958	14781

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
873	HIV EXPLORATORY RSCH	10842	9532	10971	11313	11555	11424	11523	11608

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, and candidate vaccines for prevention and treatment of human immunodeficiency virus (HIV). This program is jointly managed through an Interagency Agreement between the U.S. Army Medical Research and Materiel Command and the National Institute of Allergy and Infectious Diseases. Main efforts include construction and preclinical development of candidate vaccines, including small animal and non-human primate studies, initial clinical development in humans, 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. 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, Silver Spring, MD and its overseas laboratories; and the Naval Medical Research Center, Silver Spring, MD and its overseas laboratories. Most work is conducted under a cooperative agreement with the Henry M. Jackson Foundation, Rockville, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, constructed additional candidate vaccines that induce broader anti-HIV immune responses against various HIV subtypes found outside the United States, which are problematic in military deployments; continued genetic analysis of HIV subtypes isolated in Africa for integration into vaccine candidates for this region; developed HIV vaccine study populations for future field trials in Kenya and Uganda; supported global surveillance of HIV-1 and informed the U.S. military of the HIV threat in areas of potential troop deployment; maintained U.S. Military Clinical Intervention Network operated through Military Medical Treatment Facilities to study the frequency and impact of HIV/AIDS (Acquired Immune Deficiency Syndrome) in/on military populations; identified cost-effective drugs and care strategies to control HIV infection and transmission in military populations. In FY05, perform preclinical testing of candidate vaccines; continue genetic analysis of HIV subtypes isolated in Africa for integration into vaccine candidates for this region; continue field trials site development in Kenya, Uganda, and prepare Cameroon site for field trials; maintain global surveillance network for HIV-1 infections; maintain U.S MCIN operated through Military Treatment Facilities to study the frequency and impact of HIV/AIDS in/on military populations. In FY06 and FY07 will continue: preclinical testing of candidate vaccines; genetic analysis of HIV subtypes isolated in Africa for integration into vaccine candidates for this region; continue field trials site development in Tanzania and other regions most appropriate for clinical trial; to maintain global surveillance network for HIV-1 infections. Will continue to maintain: U.S. MCIN operated to study the frequency and impact of HIV/AIDS in/on military populations; technical watch for new antiretroviral drugs.	10842	9532	10971	11313
Totals	10842	9532	10971	11313

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
874	CBT CASUALTY CARE TECH	8782	7613	15625	13599	11997	9141	9220	9287

A. Mission Description and Budget Item Justification: This project investigates potential treatments for weapons-induced trauma and shock caused by severe blood loss on the battlefield. This project funds the core technology base to develop concepts, techniques, and materiel for the treatment and return-to-duty of warfighters wounded in combat and to support low-intensity combat as well as military operations other than war. The primary goal is to provide technologies that save lives far-forward and maintain critical care at all levels of the battlefield. Major efforts include: hemorrhage control, blood and resuscitative fluids; combat trauma therapies; far-forward medical systems; and combat casualty bioinformatics and simulation. Applied research in combat casualty care focuses on the evaluation of concept feasibility for drugs, biologics, and diagnostics for resuscitation and life support as well as designing trauma care systems for advanced monitoring and testing, emphasizing products for forward medic and surgeon use. Major efforts center on resuscitation and life support to include blood products; resuscitation fluids; drugs and devices to control severe bleeding; methods to minimize, repair, and prevent injury; diagnostic and predictive indicators for remote triage and computerized, autonomous patient care; and casualty data gathering and mining and development of training simulators. Selected technologies are integrated in to the Medical Mission Packages incrementally to provide comprehensive far forward treatment to meet Future Force requirements. Project also funds research to reduce evacuations due to dental disease and reduce the medical logistics footprint 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 Technology Area Plan (DTAP). Work in this project is performed by the U.S. Army Institute of Surgical Research, Fort Sam Houston, TX, U.S. Army Research Institute of Environmental Medicine, Natick, MA, and the Walter Reed Army Institute of Research, Silver Spring, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
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 FY04, conducted animal studies of candidate drugs for restoring clotting in casualties with abnormalities; conducted in vitro testing and scientific characterization of freeze-dried plasma; identified three promising complement activation inhibitors. In FY05: complete animal studies of drugs to evaluate their potential to restore clotting function in casualties with abnormalities and submit Investigational New Drug (IND) application to the U.S. Food and Drug Administration (FDA) for the most promising candidate; conduct animal testing of freeze-dried plasma; complete the evaluation of clotting factor activity stability; select best method for rapid inactivation of blood-borne pathogens; complete studies of low-volume fluid resuscitation; identify new candidate additives for fluids to improve resuscitation. In FY06 will complete: animal studies and sample analyses in blood coagulation studies; determination of freeze-dried plasma production techniques; begin studies of post-transfusion survival; engage a corporate partner with a Good Manufacturing Practices compliant facility for manufacturing freeze-dried plasma; conclude comparative studies of next generation resuscitation fluids; test approved complement inhibitors in animals to determine their safety; refine model for assessing resuscitation requirements. In FY07 will: scale up production of freeze-dried plasma; complete stability studies, and submit IND application to the FDA; select best technology for pathogen inactivation; recommend best new fluid for resuscitation; and select the most promising compliment activation inhibitor and introduce into clinical trials.	3953	3046	7855	6339

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Combat Trauma Therapies - including discovery and development of drugs, biologicals, and medical procedures to minimize the immediate and long term effects from battlefield injuries. In FY04: conducted experiments on an antimicrobial wound-cleaning device that was at least as good as current therapies, and on lightweight materials and splints for fracture stabilization; characterized a highly innovative and novel experimental model of penetrating "ballistic-like" brain injury; evaluated candidate neuroprotective drugs in cell culture that increase survival in an animal model of brain injury; and completed studies demonstrating that recombinant Factor VIIa is neuroprotective when administered to rats prior to a non-penetrating injury. In FY05: down-select and conduct clinical testing of an advanced prototype wound protective barrier device and submit an Investigational Device Exemption application to the FDA; continue studies in animal models to determine the effectiveness of candidate drugs to mitigate brain injury after head trauma; and conduct neuroprotection drug studies in the penetrating head injury (PHI) model to identify a drug to improve survival and residual brain function in casualties with brain injury. In FY06 will: evaluate wound cleaning/rapid debridement (surgical removal of foreign matter and dead tissue from a wound) and tissue viability assessment devices in animal models and select best bone substitute; use the PHI model in further studies to evaluate the body's response mechanisms to a PHI. In FY07 will: establish antimicrobial activity profiles in animals; study results of varying wound cleaning times; complete guidelines for resuscitation and evacuation of head-injured patients; and evaluate neuroprotective drugs.	1328	1443	2125	3273

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
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. In FY04: conducted proof of concept of collapsed lung detector; completed down-selection of the Life Signs Detection System for the Warfighter Physiological Monitoring System (WPSM); successfully completed a Phase 2 animal toxicity study of a candidate chemical additive for Meals Ready To Eat (MREs) that kills dental disease organisms and has no inherent toxicity and incorporated newly developed surface activating agents to aid in penetrating oral biofilms; and began research efforts into formulation and application methodology of an anticavity/antiplaque food additive to prevent dental disease. In FY05: design algorithms and sensors for closed loop life support; fabricate prototype collapsed lung detector; complete multiple initial WPSM sensor suite algorithms; and establish efficacy of antimicrobial agents against pre-existing dental biofilm. In FY06 will: complete integrated design for closed loop system host platform; integrate initial sensor suite and algorithms into Personal Area Network (PAN); complete integration into the Future Force Warrior Advanced Technology Demonstration; continue conducting experiments to provide additional data for identification of markers of impending shock and development of algorithms; evaluate relationships among variables that signal cardiovascular collapse and indicate the need to apply a Life Saving Intervention (LSI); and complete anticaries (prevents cavities and dental decay) delivery method formulation. In FY07 will: complete analysis of data to obtain algorithms for prediction of cardiovascular collapse and indicate the need to apply a LSI; establish antimicrobial activity profiles against dental caries in animals.	2198	2510	5158	3222

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Combat Casualty Bioinformatics and Simulation - including a far-forward-compatible system for creation and management of patient records and theater regulation of patient flow, and development of casualty simulations and durable, realistic simulators for initial and reinforcement training of care providers. In FY04: incorporated the WPSM data set into the system and augmented functionalities to include query of time-series data and user-customization of the visualization of the time-series data; initiated the development of algorithms to assess the quality of the low-frequency time-series data, such as heart rate; conducted an extensive fact-gathering effort with the Army Medical Department Center and School's Department of Combat Medic Training; continued to identify and measure tissue properties for vocal cord, liver, and spleen tissue; received recognition of the VIRGIL™ Chest Trauma Training System as 1 of 10 "Army's Greatest Inventions of the Year" for 2003. In FY05: design extraction tools and data analysis algorithms and extend graphical tools and user interfaces; mature a prototype patient simulator with advances in materiel sciences, including realistic skin and physiologically accurate injuries, sensor technologies, miniaturization/packaging technology and ad hoc wireless networking. Complete algorithms that assess the quality of the low-frequency time-series data. In FY06 will: incorporate features to allow warehousing of data from additional studies and deliver a fully deployable system; complete tests to assess interoperability. In FY07 will mature a prototype self-correcting medical simulation training system for far-forward providers.	1303	614	487	765
Totals	8782	7613	15625	13599

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
878	HLTH HAZ MIL MATERIEL	11419	10779	12738	13753	14337	14546	14731	14900

A. Mission Description and Budget Item Justification: This project supports the Medical and Survivability technology areas of the Future Force with focused research for the soldier on protection from health hazards associated with materiel and operational environments. Emphasis is on identification of health hazards inherent to the engineering design and operational use of equipment, systems, and material used in Army combat operations and training. Major efforts include: laser protection; injury protection; soft body armor and evironmental extreme protection; and biomonitor system/dehydration research. Specific hazards include: repeated impact/jolt in combat vehicles and aircraft; blast overpressure and impulse noise generated by weapons systems; toxic chemical hazards associated with deployment into environments contaminated with industrial and agricultural chemicals; nonionizing radiation-directed energy sources (laser); and environmental stressors (e.g., heat, cold, and terrestrial altitude). Specific research tasks include: characterizing the extent of exposure to potential hazards; delineating exposure thresholds for illness or injury; identifying exposure thresholds for 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, Silver Spring, MD; U.S. Army Research Institute of Environmental Medicine, Natick, MA; the United States Army Center for Environmental Health Research, Fort Detrick, MD; and the U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Laser Protection Research - In FY04, transitioned genomic/proteomic (study of protein expression and function)-derived laser eye injury treatments through a non-human primate model and characterized protective efficacy of a frequency agile particle cell switch for military sights Results support use of non-linear particle cell switches in military optics. Evaluated emerging genomic and proteomic derived treatment strategies to identify effective treatments. In FY05:demonstrate advanced electrodiagnosis and advanced retinal imaging to assess the efficacy of treatments for laser induced injury; complete the State- of-the-Art Report on the Biomedical Implications of Military Laser Exposure. In FY06 will transition triage, treatment and protection strategies based upon the classification of the laser-induced retinal injury. In FY07 will conduct advanced neuroprotection studies for the prevention of retinal and brain cell injury.	3654	3685	3452	3653
Injury Protection (tactical vehicles, face/eye) - In FY04, provided validated repeated jolt guidelines and proposed standards for safe operations of tactical ground vehicles for use in the Health Hazard Assessment program. These guidelines and standards are used in weapon system development programs to assess the ride quality of tactical ground vehicles and identify risk of injury during normal vehicle operations. Provided performance standards for effective military restraint systems to guide vehicle developers to safer designs. Establish minimum performance levels of occupant restraint systems for use by vehicle developers. In FY05, conduct epidemiological review of blunt and penetrating face and eye injury. In FY06 will develop face and eye computational models and injury dose-response models. In FY07 will validate computational and physical models of the face and eye and propose injury-based protection criteria.	1303	794	2772	3247

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Soft Body Armor and Environmental Extreme Protection - In FY04: developed and tested soft body armor (SBA) impactor; completed animal tests with SBA impactor; completed porcine (derived from swine) and human finite element models (FEMs); developed anthropomorphic (i.e. human form) test module; and characterized forces behind hard body armor (HBA), resulting in a validated scientific method for predicting blunt trauma injuries behind body armor. In FY05: conduct animal studies with HBA impactor; use FEM to scale animal injury model to human injury model; and develop body armor blunt trauma injury prediction software. In FY06 will: validate anthropomorphic test module with animal test data and transition valid body armor testing method with human injury prediction software to the Research, Development and Engineering Command/Natick Soldier Center; conduct small animal cognitive performance tests, integrate results, and release interim Toxic Gas Assessment Software - Performance Evaluator results to the Center for Health Promotion and Preventive Medicine. In FY07 will conduct large animal physical performance tests and validate the Toxic Gas Assessment Software - Performance Evaluator against large animal physical performance data.	3605	3337	3300	3506
Biomonitor System/Dehydration Research - In FY04, completed initial technology assessment for the environmental sentinel biomonitor system, which identifies threats to drinking water quality. Through the Integrated Product Team process, reduced the number of candidate toxicity sensor technologies for the environmental sentinel biomonitor system from 38 to 13. In FY05, evaluate and select biomonitor components for the environmental sentinel biomonitor for rapid identification of acute toxic hazards in water. In FY06 will: evaluate and select environmental sentinel biomonitor components; determine dehydration consequences for cold and high mountain missions. In FY07 will: complete environmental sentinel biomonitor platform and expert system development; develop models to predict water needs for broad spectrum of modern missions in environmental extremes.	2857	2963	3214	3347
Totals	11419	10779	12738	13753

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
879	MED FACT ENH SOLD EFF	8868	9736	9821	9940	10158	10270	10369	10454

A. Mission Description and Budget Item Justification: This project supports the Medical and Survivability technology areas of the Future Force with research for the soldier focused on preventing health and performance degradation in the military environment. Emphasis is on identification of baseline physiological performance and assessment of degradations produced by operational stressors. This database and collection of rules and algorithms for performance degradation in multistressor environments form the basis for the development of behavioral, training, pharmacological, and nutritional interventions to prevent decrements and sustain soldier performance. Key stressors include: psychological stress from isolation, new operational roles, and frequent deployments; inadequate restorative sleep; prolonged physical effort and inadequate hydration in extreme environments; desynchronization of biological rhythms during deployments across multiple time zones and 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, Silver Spring, MD; U.S. Army Research Institute of Environmental Medicine, Natick, MA; and the U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Nutritional and High Altitude Research - In FY04, conducted heat evaluations on individual performance using existing operational and functional models of heat stress, resulting in a capability to predict variability in these performance components for individual outcomes based on environmental and operational variables. Completed a nutritional assessment of the effects of varied protein and energy intake levels on Warfighter diet. Results demonstrated that neither protein nor energy intake levels precluded a loss of body mass or lean mass in soldiers during extended field operations. In FY05, identify performance enhancing nutritional supplements for incorporation into altitude rations. In FY06 will develop pre-deployment doctrine to time compress altitude acclimatization. In FY07 will develop prediction models of altitude acclimatization, illness incidence, and work performance.	2215	2364	2377	2407
Fatigue/Sleep Research - In FY04, determined and modeled recovery rates following acute sleep deprivation vs. chronic sleep restriction, facilitating specification and prediction of the extent to which alertness and performance capacity vary across differing levels of sleep loss. In FY05, determine and model the effects of escalating doses of fatigue countermeasures. In FY06 will produce in the laboratory an initial version of the Fatigue Intervention Recovery Model (FIRM) that predicts recovery, variability, and countermeasures effects. In FY07 will conduct field studies to validate the FIRM predictions for militarily relevant performance.	1641	1984	2015	2039
Mental Health Research - In FY04, conducted a number of studies that identified factors that predict high rates of mental disorders and their association with readiness, particularly attrition. These findings have contributed to several major programs to reduce the burden of mental health problems associated with deployment, including the Army Deployment Cycle Support Program and the medical screening evaluation. In FY05, propose effective methods for psychological health screening in deployed troops. In FY06 will field test strategies such as psychological debriefing (e.g., following traumatic events) to reduce psychiatric illness in soldiers. In FY07 will develop criteria for identifying training and operational environments where soldiers are most susceptible to psychiatric illness.	2861	3359	3394	3435

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Vision and Auditory Research - In FY04, conducted study to determine impact of refractive surgery (photo refractive keratectomy (i.e., excision of a portion of the cornea) and laser insitu keratomileusis) on vision and flight performance and conducted study of visual detection model for displays and complex targets. Findings from refractive surgery study supported new Army Surgeon General policy for refractive surgery for Army aviators. The validation of the visual detection model was the final stage in developing a first-order model of the observer's visual and decision-making processes in target detection tasks. In FY05, define visual performance and image interpretation measurements for advanced displays, sensors, and optical materials. In FY06 will summarize the ability of hearing-impaired soldiers to use virtual auditory displays for speech and non-speech signals, and produce external peer reviewed, medically based auditory display guidelines for Army warfighters regardless of hearing profile. In FY07 will model warfighter visual perception, physiology, and performance for various monocular, binocular, and biocular display devices and optical media.	2151	2029	2035	2059
Totals	8868	9736	9821	9940

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FH2	FORCE HEALTH PROTECTION - APPLIED RESEARCH	0	0	7744	8458	8590	8761	8935	9112

A. Mission Description and Budget Item Justification: Force Health Protection (FHP) Research seeks to enhance protection of Service members against health threats in military deployments both by increasing our understanding of military health issues through applied research and by applying findings from a decade of research on the etiology (cause and origin of disease) and treatment of Gulf War Illnesses (GWI). FHP research is conducted in close coordination with the Department of Veterans Affairs. It includes five thrust areas: (1) global health monitoring, (2) health behavior interventions, (3) health risk communication, (4) health risk assessment methods, and (5) medical materiel safety. This project 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 in this project is performed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA; the Naval Health Research Center, San Diego, CA; and the U.S. Army Center for Environmental Health Research, Fort Detrick, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Health Research - In FY06 will demonstrate preliminary associations between military service and specific illness and injury consequences. In FY07 will conduct major data collection through recruitment of new cohort of 20,000 Service members. The primary objective for this study is to compare change in health status between deployed and non-deployed personnel and the adjusted incidence rates of chronic disease between cohorts. Secondary objectives include comparing the adjusted change in health between the cohorts based on self-assessed physical and mental well being, mental health diagnoses from the Patient Health Questionnaire diagnostic assessment, and the post-traumatic stress disorder assessment. This study will serve as a foundation upon which other routinely captured medical and deployment data may be added to answer future questions regarding the health risks of military deployment, military occupations, and general military service.	0	0	3200	3430
Health Behavior/Weight Control - In FY06 will evaluate the effectiveness of health behaviors training program (sexually transmitted diseases, unintended pregnancy, and sexual violence prevention), comparing co-ed training in Army initial entry training (IET), with single gender training in Marine IET. In FY07 will determine the benefit of the use of new anti-obesity agents for treatment of over weight soldiers lacking any associated co-morbidities (related sickness), as a preventive measure for later morbid conditions (e.g., hypertension).	0	0	2020	2424
Weight Control/Physical Training – In FY06 will determine the effectiveness of a comprehensive weight management program for over weight soldiers. In FY07 will demonstrate the effectiveness of physical training injury reduction guidance.	0	0	2524	2604
Totals	0	0	7744	8458

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603001A - Warfighter Advanced Technology

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		65169	77022	63754	48143	53144	53297	50897	52407
242	AIRDROP EQUIPMENT	9293	7010	3841	3949	4131	4189	4225	4256
543	AMMUNITION LOGISTICS	910	1487	1449	1397	1464	1485	1498	1508
C07	JOINT SERVICE COMBAT FEEDING TECH DEMO	2189	2366	2430	2511	2593	2625	2648	2667
J50	FUTURE WARRIOR TECHNOLOGY INTEGRATION	43242	49143	56034	40286	44956	44998	42526	43976
J52	WARFIGHTER ADVANCED TECHNOLOGY INITIATIVES (CA)	9535	17016	0	0	0	0	0	0

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. Per FY05 congressional direction, the FFW program is being consolidated with the Land Warrior (LW) program (managed by Program Executive Office (PEO) Soldier) to focus on Future Combat Systems (FCS) compatibility and realize benefits from the combined effort. The FFW Science and Technology program will demonstrate technologies to provide a lightweight, head-to-toe 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 Joint Precision Airdrop System, an Advanced Concept Technology Demonstration (ACTD) begun in FY04 in partnership with the US Air Force, will demonstrate a 5-ton payload, high

altitude precision airdrop system with an on-board mission planning capability. 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 Reliance 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 Natick Soldier Center, Natick, MA; the Armament Research, Development, and Engineering Center, Picatinny, NJ; and the Research, Development, and Engineering Command, Edgewood MD.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	68034	70609	55982
Current Budget (FY 2006/2007 PB)	77022	63754	48143
Total Adjustments	8988	-6855	-7839
Net of Program/Database Changes			
Congressional Program Reductions	-6661		
Congressional Rescissions			
Congressional Increases	17750		
Reprogrammings			
SBIR/STTR Transfer	-2101		
Adjustments to Budget Years		-6855	-7839

Change Summary Explanation:
FY06 - Funds realigned ($6855K) to higher priority requirements.
FY07 - Funds realigned ($7839K) to higher priority requirements.

Nine FY05 Congressional adds totaling $17750 were added to this PE.

FY05 Congressional adds in Project J52 with no R2-A:
($960) Antimicrobial/Medical Base Layer Garment Technology: The purpose of this one-year Congressional add is to evaluate antimicrobial/medical technologies for clothing that may provide increased protection against infection. No additional funding is required to complete this project.

($2493) Common Navigation Interface Unit for Joint Precision Aerial Delivery System (JPADS): The purpose of this one-year Congressional add is to develop a JPADS-compatible low-cost Common Navigation Interface Unit for payload delivery pallets and parafoils. No additional funding is required to complete this project.

($479) Electro-textiles: The purpose of this one-year Congressional add is to research electro-textile technology with potential to advance "cableless" power and data transfer capabilities with reduced weight and bulk over onventional "wired" systems. No additional funding is required to complete this project.

($959) Integrated Headgear: The purpose of this one-year Congressional add is to research lightweight ballistic face protection. No additional funding is required to complete this project.

($1438) Joint Precision Aerial Delivery System (JPADS) - Rapid Refueling of 2K lb Resupply Requirements: The purpose of this one-year Congressional add is to develop common interface technology to improve the logistics of 2,000 lb payload resupply airdrop systems. No additional funding is required to complete this project.

($2446) Multifunctional Protective Packaging Technology: The purpose of this one-year Congressional add is to develop smart packaging prototype materials/films/coatings having potential to increase security of packaged foods. No additional funding is required to complete this project.

($4891) Ration Packaging Materials and Systems for Meals-Ready-to-Eat: The purpose of this one-year Congressional add is to evaluate oxygen-scavenging packaging materials to determine their potential to improve food shelf life. No additional funding is required to complete this project.

($2397) Small Business Development and Transition: The purpose of this one-year Congressional add is to advance small business research having potential for military utility. No additional funding is required to complete this project.

($959) Technology for Human Systems Integration: This one-year Congressional add is to research human factors engineering technology for Soldier systems. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
242 AIRDROP EQUIPMENT	9293	7010	3841	3949	4131	4189	4225	4256

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 and to deliver payloads with improved accuracy, which enhances cargo, crew, and aircraft survivability. The Joint Precision Airdrop System Advanced Concept Technology Demonstration (ACTD) will demonstrate a 10,000 lb precision capability from up to 20 miles offset with 100 meter Circular Error Probable (CEP) accuracy. 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 Natick Soldier Center, Natick, MA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Aerial Delivery of Cargo - In FY04, performed prototype design and fabrication, and started system integration with USAF high-altitude airdrop mission planning system known as Precision Aerial Delivery System and the 10,000 lbs Army Joint Precision Airdrop System (formerly PEGASYS) for the Joint Precision Airdrop System ACTD; successfully demonstrated autonomous flight of two decelerator concepts. In FY05, complete system integration; conduct technical testing and user training; and demonstrate a high altitude (25,000 ft. Mean Sea Level) deployable, autonomous, offset airdrop capability (goal 10-20 miles offset) with the option to deliver separate and distinct payloads (up to 10,000 lbs total) to multiple locations.	3816	2090	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Medium Precision Airdrop - In FY04, evaluated competing concepts for a 30,000 lb payload system; matured two promising concepts through scale-size prototypes; developed and integrated sensor suites for guidance navigation and control (GN&C) subsystems; and evaluated tools to model large parafoils. In FY05, conduct full-scale component prototyping; continue scale-model evaluations of two competing concepts; complete GN&C systems design integration and bench testing; begin component level modeling; and evaluate advanced textile materials to improve performance and reduce cost. In FY06, will perform component and GN&C evaluations; will begin full-scale system design; will complete component level modeling and begin system modeling; will complete evaluation of advanced textile materials; and will integrate intermodal platform. In FY07, will complete all component-level evaluations, system design, and system modeling; and will begin system evaluation and system control logic validation.	4521	4420	3841	3949
Personnel Parachute Technology – In FY05, pursue parachute safety enhancements for the Advanced TActical Parachute System (ATAPS) Preplanned Product Improvement program to improve aerodynamics, reduce drag, and enhance parachute opening control.	0	500	0	0
Affordable Guided Airdrop System – This one-year Congressional add advanced the conversion and use of military inventory round cargo parachutes for autonomous control of 500-2200 lb payloads for use in high altitude deployments, reduced the system's airborne guidance unit weights and complexities, and explored new concepts to increase the glide ratio of round canopies. No additional funding is required to complete this project.	956	0	0	0
Totals	9293	7010	3841	3949

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
543	AMMUNITION LOGISTICS	910	1487	1449	1397	1464	1485	1498	1508

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 Modular Intermodal Platform (MIP), which facilitates logistics through it's compatibility with the Theatre Support Vessel; C-17 and C-130 aircraft; current and future trucks; and aerial delivery systems. The MIP's modularity and compatibility will reduce aircraft load/unload time by up to 75%, 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 U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Smart Distribution- Modular Inter-modal Platform (MIP) - In FY 04, modeled performance characteristics and matured design for lightweight MIP. In FY 05, fabricate prototypes and conduct hardware and interface evaluations. In FY06, will complete design modifications and conduct inter-modal operational tests.	910	1487	1449	0
Ammunition Embedded Condition Monitoring and Identification System - In FY 07, will incorporate low power, miniaturized sensor technology into an embedded system to provide remote condition monitoring of key components for Future Combat Systems such as the Medium Range Munition, and item identification for asset management. This work leverages applied research in prognostics and diagnostics performed by the Army Research Laboratory.	0	0	0	1397
Totals	910	1487	1449	1397

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
C07	JOINT SERVICE COMBAT FEEDING TECH DEMO	2189	2366	2430	2511	2593	2625	2648	2667

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 demonstrates 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 by 75% (in component parts, weight, cube, fuel and water) and labor requirements by 50%, while improving the quality of food service. The work in this project is performed and managed by the U.S. Army Natick Soldier Center, Natick, MA with oversight from the DoD Combat Feeding Research and Engineering Board and Nutrition Committee. This project has collaborative efforts with the U.S. 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 2004	FY 2005	FY 2006	FY 2007
Equipment and Energy Technologies – In FY04, conducted multi-service Field Feeding and Advanced Sustainment Technology demonstrations reducing logistics (75% reduction in weight, cube, fuel and water; 50% reduction in labor). In FY05, complete design and fabrication of a thermoelectric water heater chiller for Future Combat Systems (FCS) crew sustainment that weighs less than half of the current Mounted Water Ration Heater and provides chilled water to vehicle crews. In FY06, will demonstrate and transition thermoelectric water heater chiller for FCS crew sustainment; will demonstrate Capillary Force Vaporizer (solid state vaporizer with no moving parts and constructed of layered ceramics) stove and associated equipment, and transition for fielding through the Soldier Enhancement Program and the Marine Enhancement Program. In FY07, will demonstrate and transition thermoelectric self-powered tray ration heater for Army, US Marine Corps and Air Force kitchens; and will conduct initial demonstrations of waste to energy conversion technologies.	958	613	624	640
Technologies for Novel Ration Preservation & Stabilization, Revolutionary Packaging and Food Safety – In FY04, completed and transitioned Compressed Meal technology prototypes offering menu items with up to 38% reduced weight and 33% less cube over the Meal Ready to Eat (MRE). Demonstrated in a field environment Radio Frequency Identification (RFID) System technology (vendor to foxhole), evaluated field data and transitioned system to Defense Logistics Agency (DLA) in accordance with Under Secretary of Defense for Acquisition Technology & Logistics signed DoD policy for the use of RFID within DoD. In FY05, validate/optimize diagnostic techniques to detect chemical/biological agents and/or naturally occurring food pathogens in food matrices and incorporate into biosensor detection systems; demonstrate and transition a surface scanning biosensor; and evaluate advanced prototype film produced using nanocomposites and enhanced barrier coating technology in ration packaging. In FY06, will identify and obtain commercial or prototype array diagnostic systems and validate for four food pathogens from different complex food matrices; will investigate technologies to achieve increased coating adherence during/after thermostabilization of ration components; and will modify and optimize tamper evident devices, and transition pending DLA concurrence. In FY07, will continue to validate array diagnostic technologies with complex food matrices; and will optimize and conduct technical demonstration of increased coating adherence that will enhance appearance and consumption of thermally processed foods.	575	1364	1306	1360

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Technologies for Nutrients and Novel Delivery Systems – In FY04, demonstrated production scale-up capability and incorporated shelf stable meat/vegetable bars and gels, breakfast bagel and French toast components, and shelf stable tuna fish and tortillas in prototype First Strike Ration (FSR); conducted field demonstration of FSR technology in various operational scenarios (Army Special Operations Forces /Marines) with incorporated packaging and component modifications providing a 50% reduction in cube/weight, as compared to the MRE. In FY05, determine stability of encapsulated proteins appropriate for thermally processed components; develop tests for supplements and conduct limited field evaluation; and finalize and transition FSR component/menu/packaging. In FY06, will demonstrate effectiveness of protein encapsulation in thermally and non-thermally processed FSR components. In FY07, will complete optimization and final product evaluation of FSR supplements.	656	389	500	511
Totals	2189	2366	2430	2511

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J50	FUTURE WARRIOR TECHNOLOGY INTEGRATION	43242	49143	56034	40286	44956	44998	42526	43976

A. Mission Description and Budget Item Justification: This project matures high-payoff technologies and systems for the Future Force Soldier with primary emphasis on the Future Force Warrior (FFW) System of Systems (SoS). The FFW program utilizes technology integration and multi-functionality to enhance warfighting capability for the individual Soldier and small combat unit while reducing Soldier load. Per FY05 congressional direction, the FFW program is being consolidated with the Land Warrior (LW) program (managed by Program Executive Office (PEO) Soldier) to focus on Future Combat Systems (FCS) compatibility and realize benefits from the combined effort. Consolidation activities with PEO Soldier include migration of FFW technology development to the same contractor as LW and the establishment of a combined organizational structure. The project develops architectures, and develops/leverages and integrates key technologies in Soldier Systems that transition to PEO Soldier for fielding to the Future Force Unit of Action (UA). As part of the consolidated Soldier modernization strategy, this project is providing technology aligned with the FCS spiral development strategy that will result in fielding of an integrated modular Ground Soldier System (GSS) that is fully compatible with FCS. This project develops technology to provide dismounted warfighters in the UA with significant overmatch capability in the areas of survivability, networked communications, individual Soldier and small team lethality, and agility while enabling them to operate for extended periods under arduous combat conditions, with minimal loss in physical capabilities from fatigue, stress, and hardship. The FFW SoS will employ open system architectures and moderate-high risk/high payoff technologies to yield a lightweight system-engineered protective combat ensemble, employing modular plug and play components such as multi-function sensors, networked communications/collaborative situational awareness, enhanced positioning navigation, networked fires, collaborative embedded training, medical status monitoring capabilities, and manportable ("micro") air and ground robot/sensor platforms organic to the squad. This Soldier SoS will have connectivity to other dismounted personnel, Future Force platforms including FCS, and robotic air/ground vehicles to form adaptive, distributed sensor networks for better situational understanding of local environments and threats. The project will also leverage squad-relevant FCS unmanned systems (e.g., Mule) and demonstrate mission packages tailored to the squad. The FFW Concept and Technology Development (CTD) program began in FY02 with two competing industry teams developing and maturing initial FFW concepts for all Future Force UA Soldiers; then downselected to a single contractor team to conduct technology design and maturation of a "common core" SoS configuration and dismounted variant; and will culminate with a comprehensive SoS capstone demonstration in FY07. Key performance goals are to demonstrate: a Soldier borne system with fighting load of no more than 50 lbs per warfighter (rifleman); the ability to operate for 24 hrs autonomously at the individual level and 72 hrs at the Unit of Action level; interoperability with Warfighter Information Network-Tactical/Joint Tactical Radio System (JTRS) Cluster 5 through integration of the Soldier Radio Waveform (SRW); and compatibility with FCS. The project will mature and integrate Soldier SoS technologies transitioned from 0602786A, 0602105A, 0602308A, 0602623A, 0602705A, 0602782A, 0602785A, 0602787A, 0603002A, 0603008A, and 0603607A. The FFW program works closely with the Army's FCS and JTRS/ Squad Level Communications programs, as well as other Army Science & Technology (S&T) and DoD programs, in order to ensure interoperability, prevent possible duplication of efforts, and maximize return on investment to the Army. To address early component insertion that enhances current Soldier capabilities, the FFW program has established a Transition Working Group to identify and transition early

maturing technologies/capabilities to PEO Soldier acquisition programs. 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 Natick Soldier Center, Natick, MA manages this project.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
FFW Technology Integration Cycle I - In FY04, completed FFW Technology Integration Cycle I which included the following efforts. Refined operational concepts and architecture, including distribution of capabilities across small combat units. Developed technical performance measures for each design cycle; allocated subsystem weight and power budgets, and developed initial high level specifications (e.g. Interface Control Documents). Developed initial Soldier Borne System (SBS) prototype architecture to include load carriage and signature management. Conducted Modeling and Simulation (M&S) to assess utility. Established System Integration Lab (SIL) to assess functionality. Began development of FFW subsystems that include the following: Headgear systems - evaluated headgear component technology candidates including ballistic materials, hearing and vision augmentation/protection, and chemical/biological protection. Communications - defined hardware/software interfaces and integration requirements for Joint Tactical Radio System (JTRS) Cluster 5 and the Soldier Radio Waveform. Power - initiated requirements definition (including trade-off analyses) and developed power sources/power management tools to meet needs for operational mission scenarios. Lethality - defined initial distribution of capabilities, and began development of interfaces for individual weapons and networked fires. FFW SoS platforms - developed initial surrogate architecture to represent objective architecture for integration with FCS platforms. Software - defined software architecture and interfaces for information management and battlefield applications; began software development. Warfighter Physiological Status Monitoring - assessed monitoring technology developed by Army Medical Research and Materiel Command, and defined requirements for integration into Personal Area Network. Embedded training - developed concepts for embedded training, and evaluated display device options.	19224	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
FFW Technology Integration Cycle II-FY04: developed lower level specifications, designed components, conducted trade-off studies. Matured SBS integration from initial prototype, advancing ballistic protection and load carriage subsystems. Conducted initial assessment of linkage to FCS SoS Common Operating Environment. Identified 13 early insertion technology candidates for transition to Program Manager Soldier Equipment in FY06. FY05: fabricate Cycle II SBS prototypes and surrogates; perform evaluations in a SIL and relevant field environment. Conduct M&S, and field assessments with soldiers to obtain feedback for further refinement; evaluate systems requirements and preliminary design. Identify technology objectives for FCS spiral insertions. Continue Soldier SoS concept aligned with FCS Spiral 2 with subsystem development including: Headgear system-integrate video and processing/network/communication surrogate. Personal Area Network-develop proof-of-concept Soldier borne computer system and initiate integration of body borne antennae. Communications-conduct lab and limited field tests with prototype hardware and digital audio support, to evaluate SRW effectiveness for dismounted voice/data communications. Power-develop mission profiles and power duty cycles. Lethality-mature interfaces between SBS and individual weapons; demonstrate connectivity to weapon mounted fire control system. Soldier/platform interfaces-conduct demonstration of Soldier control of unmanned systems; develop interface specifications for unmanned and manned vehicles. Software-develop initial modules for interfaces and embedded training. Warfighter Physiological Status Monitoring-integrate into Personal Area Network.	24018	20555	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
FFW Technology Integration Cycle III- In FY05, begin FFW Technology Integration Cycle III that includes the following efforts that will continue into FY06. Fabricate fully functional prototypes with distribution of capabilities that are compatible and coordinated with the FCS spiral strategy including integrated position/navigation; antennas; electronics; warfighter physiological status monitoring; and headgear system. Evaluate system functionality and perform modeling and simulation analysis. Develop initial Limited Objective Experiments and Capstone Demonstration test plans for FY07. Focus subsystem development on integration that includes, but is not limited to, the areas listed here. Headgear system - integrate system including chemical/biological protection, video, and processing/network/radio technologies into the SBS. Personal Area Network - refine architecture and computer form factor. Communications- leverage, develop and integrate hardware and software modules and verify/validate dismounted Soldier battlefield applications using the JTRS compliant SRW . Power - integrate power sources into the SBS. Lethality - demonstrate integration of individual weapons with SBS. Soldier (robotic/unmanned platform) Interfaces - conduct robotic system integration tests with surrogate platforms to validate soldier control and wireless capabilities; conduct robotic systems deployment studies; develop sensor fusion architecture; and conduct FCS compatibility assessment. Conduct FFW SoS User Experiment and Critical Design Evaluation for hardware design lock. Continue to identify and transition early-maturing technologies and capabilities to PEO Soldier programs for early transition to the current force.	0	28588	18688	0
FFW Integration Cycle IV– In FY06 and FY07, will transition program management for and execution of the remainder of the FFW ATD to Project Manager Soldier Warrior (PM SWAR) the final FFW SoS prototype build, which will consist of assembly of 18 prototype combat ensembles with distributed capabilities including integrated position/navigation; antennas; electronics; warfighter physiological status monitoring; and headgear system (having ballistic, facial and chemical/biological protection, voice communications, fused thermal/Image-intensification, and laser sensors). Will continue modeling and simulation analyses. Will complete Limited Objective Experiment and Capstone Demonstration test plans. Will continue refinement of software subsystems including distributed capabilities and MOS-specific software modules as required. Will conduct robotic system integration tests with surrogate FCS platforms to validate soldier control and wireless capabilities. Will conduct FFW/FCS compatibility assessment. Will spiral out matured technology components for PEO Soldier modular insertions.	0	0	37346	7022

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
FFW Capstone Demonstration - In FY07, under PM SWAR management, will deliver 18 contractor tested prototype systems for the capstone FFW demonstration; will continue software refinement; will conduct Experimental Force training and Limited Objective Experiments, and associated analyses; will conduct final software integration; will conduct Experimental Force training for capstone demonstrations, and execute demonstrations. Will verify FFW SoS at Technology Readiness Level 6 and transition to PEO Soldier.	0	0	0	28264
Soldier Power - In FY07, will initiate maturation and demonstration of power and energy technologies to achieve better integrated, more efficient power subsystems for GSS and other Soldier systems. Will emphasize development of capabilities to dramatically improve energy density and duration of power sources for Soldier applications to reduce Soldier carried loads and improve mission performance. Will develop and evaluate technologies such as fuel-cells, fuel-cell/battery hybrids, and smart chargers as components of an overall soldier power subsystem. Will develop power management approaches, including advanced system monitors, power efficient software, and novel instant-on/sleep capabilities.	0	0	0	5000
Totals	43242	49143	56034	40286

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603002A - MEDICAL ADVANCED TECHNOLOGY

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		217736	299561	45160	50300	59146	56408	57029	57596
800	TELEMEDICINE TESTBED	1912	1786	3343	3887	3995	4098	4189	4282
804	PROSTATE CANCER RSCH	973	958	0	0	0	0	0	0
810	IND BASE ID VACC&DRUG	18712	16624	19253	20865	21862	22201	22401	22576
814	NEUROFIBROMATOSIS	19458	23967	0	0	0	0	0	0
819	FLD MED PROT/HUM PERF	1397	1324	1126	1179	1220	1259	1295	1330
840	COMBAT INJURY MGMT	15479	12362	19502	22255	29921	26660	26911	27131
893	TISSUE REPLACEMENT	4183	0	0	0	0	0	0	0
929	ARTIFICIAL LUNG TECHNOLOGY	973	0	0	0	0	0	0	0
932	MINIMALLY INVASIVE SURGERY (CA)	973	3451	0	0	0	0	0	0
938	TISSUE ENGINEERING	0	958	0	0	0	0	0	0
941	DIABETES RESEARCH	4865	4793	0	0	0	0	0	0
954	DIGITAL X-RAY	973	0	0	0	0	0	0	0
955	ASSISTIVE TECHNOLOGY	1946	0	0	0	0	0	0	0
969	ALCOHOLISM RESEARCH	4378	3595	0	0	0	0	0	0
970	ENZYMATIC WOUND DISINFECTANT	0	9108	0	0	0	0	0	0
97A	BIOSENSOR RESEARCH	2919	2492	0	0	0	0	0	0
97B	BLOOD SAFETY	3989	4602	0	0	0	0	0	0
97D	CENTER FOR AGING EYE	973	1917	0	0	0	0	0	0
97E	CENTER FOR PROSTATE DISEASE RESEARCH AT WRAMC	4378	4122	0	0	0	0	0	0
97N	LUNG CANCER DETECTION	5060	0	0	0	0	0	0	0
97O	LUNG CANCER RESEARCH	9243	0	0	0	0	0	0	0
97T	NEUROTOXIN EXPOSURE TREATMENT	25295	24924	0	0	0	0	0	0
97W	SEATREAT CANCER TECHNOLOGY	1946	2876	0	0	0	0	0	0
97X	SYNCHROTRON-BASED SCANNING RESEARCH	0	9778	0	0	0	0	0	0
97Z	TAFENOQUINE ANTIMALARIAL AGENT	0	7191	0	0	0	0	0	0

FH4	FORCE HEALTH PROTECTION - ADV TECH DEV	0	0	1936	2114	2148	2190	2233	2277
MB1	ADV DIAGNOSTICS & THERAPEUTIC DIG TECH	973	7191	0	0	0	0	0	0
MB2	BRAIN, BIOLOGY, AND MACHINE	2919	2876	0	0	0	0	0	0
MB3	CENTER FOR INTEGRATION OF MEDICINE & INNOV TECH	10945	11505	0	0	0	0	0	0
MB4	CENTER FOR UNTETHERED HEALTHCARE	1459	3835	0	0	0	0	0	0
MB7	HEMOGLOBIN BASED OXYGEN CARRIER	0	1343	0	0	0	0	0	0
MB9	JOINT US NORWEGIAN TELEMEDICINE	2724	1727	0	0	0	0	0	0
MC4	SECURE TELEMEDICINE TECH PROGRAM	0	958	0	0	0	0	0	0
MC7	NATIONAL TISSUE ENGINEERING CENTER	0	2397	0	0	0	0	0	0
MC9	MEDICAL SIMULATION TRAINING INITIATIVE	973	0	0	0	0	0	0	0
MD1	EMERGENCY TELEMED RESPONSE & ADV TECH	2919	1343	0	0	0	0	0	0
ME1	CHILDREN'S HOSPICE PROGRAM	973	0	0	0	0	0	0	0
ME3	INSTITUTE FOR RESEARCH AND EDUCATION	3600	3595	0	0	0	0	0	0
ME4	LASER FUSION ELASTIN	0	4602	0	0	0	0	0	0
ME6	MOBILE INTEGRATED DIAGNOSTIC/DATA ANALYSIS SYSTEM	1168	0	0	0	0	0	0	0
ME7	RURAL TELEMEDICINE DEMONSTRATION PROJECT	1946	0	0	0	0	0	0	0
ME8	STABLE HEMOSTAT	2919	0	0	0	0	0	0	0
ME9	BEHAVIORAL/COMPARATIVE GENOMICS	1946	2492	0	0	0	0	0	0
MF1	3D IMAGING & GENOMIC ANAL - BREAST CANCER MGT (CA)	1655	0	0	0	0	0	0	0
MF2	ADVANCED PROTEOMICS (CA)	1168	0	0	0	0	0	0	0
MF3	BATTLEFIELD RESPIRATOR AND VENTILATOR (BRAV) (CA)	1459	1820	0	0	0	0	0	0

MF4	BIO-MEDICAL ENGINEERING CENTER (CA)	1168	0	0	0	0	0	0	0
MF5	BIOMEDICAL INFORMATION TRANSFER (BIT) (CA)	973	0	0	0	0	0	0	0
MF6	DENDRITIC NANOTECHNOLOGY RESEARCH (CA)	2919	0	0	0	0	0	0	0
MF7	ELECTRICAL IMPEDANCE SCANNING DEVICE (CA)	973	0	0	0	0	0	0	0
MF8	EMERGING TECHNOLOGIES CENTER (CA)	1459	0	0	0	0	0	0	0
MF9	GENOMIC MEDICINE AND GENE THERAPY (CA)	3307	3259	0	0	0	0	0	0
MG1	GYNECOLOGIC DISEASE PROGRAM (CA)	4135	4122	0	0	0	0	0	0
MG2	INTEGRATED INFORMATION SYSTEM (CA)	973	0	0	0	0	0	0	0
MG3	MEDICAL TRAINING TECH ENHANCEMENT INITIATIVE (CA)	973	958	0	0	0	0	0	0
MG5	NATIONAL FUNCTIONAL GENOMICS CENTER (CA)	4865	8148	0	0	0	0	0	0
MG6	NOVEL SAFE EFFECT VACCINES FOR BIODEFENSE/CANCER	6616	0	0	0	0	0	0	0
MG7	ON-LINE MEDICAL TRAINING (CA)	1703	0	0	0	0	0	0	0
MG8	OPERATING ROOM OF THE FUTURE (CA)	1946	3835	0	0	0	0	0	0
MG9	PENNINGTON BIOMEDICAL CENTER (CA)	1751	2492	0	0	0	0	0	0
MH1	PICTURE ARCHIVING AND COMMUNICATIONS SYSTEM (CA)	3405	1343	0	0	0	0	0	0
MH2	PROJECT COLLABORATION MATERIAL (CA)	973	958	0	0	0	0	0	0
MH3	PROTEOMICS CENTER (CA)	3307	4122	0	0	0	0	0	0
MH4	RAPID BIO-PATHOGEN DETECTION TECHNOLOGY (CA)	1459	0	0	0	0	0	0	0
MH5	REGIONAL ANESTHESIA AND PAIN MGMT INITIATIVE (CA)	1168	5752	0	0	0	0	0	0

MH6	RUGGED TEXTILE ELECTRONIC GARMENTS (CA)	2919	1438	0	0	0	0	0	0
MH7	STUDY OF HUMAN OPERATOR PERFORMANCE (CA)	973	2397	0	0	0	0	0	0
MH8	ACCEL DIAGNOSIS-DIGITAL IMAGING PATTERN RECOG (CA)	0	2685	0	0	0	0	0	0
MH9	ADVANCE OF NON-INVASIVE GLUCOSE MONITORING (CA)	0	958	0	0	0	0	0	0
MI1	CLINICAL ED INSTITUTE/SURGERY INTERACTIVE SYS (CA)	0	958	0	0	0	0	0	0
MI2	AD IMAGE PROCESSING TECH FOR BIOMED INFORMATICS	0	2397	0	0	0	0	0	0
MI3	ADVANCES IN BREAST CANCER CARE THERAPY (CA)	0	1246	0	0	0	0	0	0
MI4	ALLIANCE FOR NANOHEALTH (CA)	0	2685	0	0	0	0	0	0
MI5	BEHAVIORAL GENOMICS SLEEP APNEA RESEARCH (CA)	0	958	0	0	0	0	0	0
MI6	CANCER VACCINE (CA)	0	3259	0	0	0	0	0	0
MI7	COLLABORATIVE IN ADVANCED EMR WITH THE ARMY GUARD	0	2397	0	0	0	0	0	0
MI8	FULL-FEATURED PATIENT MONITOR WITH DEFIBRILLATOR	0	1438	0	0	0	0	0	0
MI9	EMERGENCY EYE CARE PROGRAM (CA)	0	958	0	0	0	0	0	0
MJ1	EXTRA CORPOREAL MEMBRANE OXYGENATION AT TRIPLER	0	5752	0	0	0	0	0	0
MJ2	FIBRINOGEN BANDAGES FOR BATTLEFIELD WOUNDS (CA)	0	3356	0	0	0	0	0	0
MJ3	FORT DETRICK TECHNOLOGY TRANSFER INITIATIVE (CA)	0	958	0	0	0	0	0	0
MJ4	HANDS FREE ELECTRONIC HEALTH RECORD (CA)	0	958	0	0	0	0	0	0
MJ5	IMPROVED LUNG CANCER MGMT-ADV IMAGING TECH (CA)	0	2013	0	0	0	0	0	0

MJ6	LEISHMANIASIS PREVENTION TREATMENT & DIAGNOSIS	0	7191	0	0	0	0	0	0
MJ7	LIGHT-BASED SELF TREATMENT FOR PFB (CA)	0	1438	0	0	0	0	0	0
MJ8	WRAMC HUMAN BRAIN MAPPING FOR CMBT TRAUMA RSCH	0	1727	0	0	0	0	0	0
MJ9	MEDICAL ENTERPRISE MGMT FOR THE U.S. ARMY (CA)	0	958	0	0	0	0	0	0
MK1	MEDICAL M&S THROUGH SYNTHETIC DIGITAL GENES (CA)	0	1438	0	0	0	0	0	0
MK2	METROPLEX COMPREHENSIVE MEDICAL IMAGING RESEARCH	0	6615	0	0	0	0	0	0
MK3	MILITARY SURGEON TRAINING INITIATIVE (CA)	0	958	0	0	0	0	0	0
MK5	MOBILE I V SYSTEM (CA)	0	2492	0	0	0	0	0	0
MK6	ORPHAN DISEASE DRUG DISCOVERY PROGRAM (CA)	0	1917	0	0	0	0	0	0
MK7	PEDIATRIC BRAIN TUMOR & NEUROLOGICAL DISEASE PRGM	0	1438	0	0	0	0	0	0
MK8	PLASMA STERILIZER (CA)	0	1343	0	0	0	0	0	0
MK9	PROPHET FOR COMBAT CASUALTY CARE (CA)	0	480	0	0	0	0	0	0
ML1	RARE BLOOD PROGRAM (CA)	0	958	0	0	0	0	0	0
ML2	SEAMED ORAL HEALTH PROJECT (CA)	0	1820	0	0	0	0	0	0
ML3	SOLDIER-MOUNTED EYE-TRACKING & CONTROL SYSTEM (CA)	0	1438	0	0	0	0	0	0
ML4	SUPERQR POWDER DEVELOPMENT (CA)	0	958	0	0	0	0	0	0
ML5	SURGICAL WOUND DISINFECTION & BIO AGENT DECON PROJ	0	1343	0	0	0	0	0	0
ML6	TRIPLER ARMY MEDICAL CTR EICU REMOTE CRITICAL CARE	0	3835	0	0	0	0	0	0
ML7	UNIVERSAL MEDICAL AND SURGICAL PRODUCT CATALOG(CA)	0	2397	0	0	0	0	0	0

ML8	UNIVERSAL VACCINE DEVELOPMENT FOR BIOTERRORISM(CA)	0	958	0	0	0	0	0	0
ML9	VASCULAR GRAFT RESEARCH FOR COMBAT SETTINGS (CA)	0	1727	0	0	0	0	0	0
MM1	WEIGHT MEASUREMENTS & STANDARDS FOR MIL PERSONNEL	0	1820	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element (PE) supports focused research for healthy, medically protected soldiers, funds research consistent with the Medical and Survivability technology areas of the Future Force, and assures compliance with Food and Drug Administration regulatory requirements for licensure of drugs, vaccines, and medical devices. The primary goal of this program is to provide maximum soldier survivability and sustainability on the battlefield as well as in military operations other than war.

This program element funds maturation of promising medical technologies identified during the applied research phase in the following areas: Militarily-Relevant Infectious Diseases, Combat Casualty Care, and Military Operational Medicine that includes exposure to hazardous military materiels, medical factors to enhance soldier effectiveness, telemedicine, and force health protection.

Infectious Diseases: Focuses research on medical protection against naturally occurring diseases of military importance. Methods are identified and matured for infectious disease prevention and treatment including, conducting FDA required pre-clinical and clinical safety and efficacy trials on candidate vaccines, prophylactic interventions, diagnostics and therapeutic drugs. Methods for controlling disease-carrying insect vectors are refined and tested.

Combat Casualty Care: Matures and demonstrates methods for the care of trauma and burns due to battlefield injuries. FDA pre-clinical and clinical safety and efficacy testing is included for candidate drugs, biologics, and diagnostics for resuscitation, treatment of injuries and life support. Candidate medical devices and products for the warfighter include: clotting drugs, freeze dried plasma, neuroprotective drugs, handheld acoustic energy hemorrhage control device, and assisted automated critical care system. Candidate products for prevention of combat maxillofacial (face/neck) injuries and reduction of lost time due to dental disease are refined and demonstrated.

Military Operational Medicine (MOM): Research focuses on refining and demonstrating biomedical solutions that protect soldiers and enhance their performance in the face of multiple stressors in operational and training environments. Candidate products such as soft body armor and biomonitors to protect soldiers from injuries resulting from exposure to hazardous environments and materiels are refined and demonstrated. Prevention of health and performance degradation in military environments is another important objective of MOM research. This research examines and refines selected 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. Findings from research and treatment of Gulf War Illness are used to better understand military health issues to protect Service members against health threats in military deployments.

The 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 in this PE is performed by the Walter Reed Army Institute of Research, Silver Spring, MD; U.S. Army Medical Institute of Chemical Defense, Aberdeen Proving Ground, MD; U.S. Army Medical 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; and the U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL; and for infectious disease research, the Naval Medical Research Center, Silver Springs, MD.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	38404	46905	51529
Current Budget (FY 2006/2007 PB)	299561	45160	50300
Total Adjustments	261157	-1745	-1229
Net of Program/Database Changes			
Congressional Program Reductions	-9340		
Congressional Rescissions			
Congressional Increases	279000		
Reprogrammings			
SBIR/STTR Transfer	-8503		
Adjustments to Budget Years		-1745	-1229

Change Summary Explanation:

Eighty FY05 Congressional adds totaling $279000 were added to this PE. These one year Congressional adds are listed individually as project lines in this R-2 Exhibit, and the amounts shown correspond to the amounts of the Congressional adds. No additional funds are required to complete these projects.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
800	TELEMEDICINE TESTBED	1912	1786	3343	3887	3995	4098	4189	4282

A. Mission Description and Budget Item Justification: This project supports the Medical technology area of the Future Force by developing and demonstrating future medical concepts of operations, operational architectures, and operational requirements to support forward echelon telemedicine presence, medical command and control, and collaborative planning tools for mission planning and rehearsal. Major efforts include sleep research and environmental monitor development. It funds development, evaluation, and demonstration of prototype advanced technology concepts and materiel for provision of enhanced Force Health 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 U.S. Army Research Institute of Environmental Medicine, Natick, MA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Sleep Research/Environmental Monitor - In FY04, determined the amount of recovery sleep needed following sleep restriction. Preliminary results established the number of consecutive nights of 8 hours TIB (time in bed) needed to recover from chronic sleep restriction (defined as nightly sleep restricted to 3 hours TIB across 7 nights). In FY05, conduct comparative studies of higher order mental abilities that reflect militarily relevant capacities (e.g., judgment/decision-making, distinguishing friend from foe, course-of-action determination, and situational awareness) to determine which may be degraded by sleep loss and determine if any can be restored through use of stimulants. In FY06, will develop repeatable measures of the most sensitive measures to allow detection of changes in higher order mental abilities with increasing levels of sleep deprivation (most current measures of higher-order mental abilities are single administration only) and their restoration using stimulants. In FY07, will determine efficacy of caffeine (available over-the-counter, non-proprietary stimulant) in comparison to dextroamphetamine and modafinil (prescription-only, proprietary stimulants) for restoring operationally relevant high-order mental performance versus simple psychomotor performance. Integrate Environmental Sentinel Monitor components and conduct field test.	1912	1786	3343	3887
Totals	1912	1786	3343	3887

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
810	IND BASE ID VACC&DRUG	18712	16624	19253	20865	21862	22201	22401	22576

A. Mission Description and Budget Item Justification: This project matures and demonstrates medical countermeasures to naturally occurring infectious diseases that can affect the Future Force. Infectious diseases pose a significant threat to operational effectiveness and forces deployed outside the United States. Countermeasures will protect the force from infection during sustained operations by preventing hospitalizations and evacuations from the theater of operations. Major efforts include: malaria, diarrheal, dengue, meningitis, and hemorrhagic fever vaccine development; antimalarial drug candidate testing; and insect vector control and infectious disease diagnostic development. Of major importance to the military are the parasitic disease malaria and leishmaniasis, the bacterial diseases responsible for diarrhea (i.e., caused by Shigella, enterotoxigenic Escherichia coli (ETEC), and Campylobacter), and viral diseases (e.g., dengue fever and hantaviruses). Research also develops improved materiel for control of insect/arthropod disease vectors and addresses a variety of infectious disease threats to deployed and mobilizing forces, including meningitis, viral encephalitis, and hemorrhagic fevers (e.g., hemorrhagic fevers with renal syndrome (HFRS)). Improved diagnostic capabilities are also pursued that enable rapid battlefield identification and management of diseases and allow informed medical operational and tactical decisions. Program goals include preclinical and clinical testing of protein and DNA vaccines; testing new technologies to enhance effectiveness and duration of vaccines; compounding and testing multicomponent vaccines to provide protection against multiple disease strains; producing vaccines and antimalarial drugs under U.S. Food and Drug Administration (FDA) regulated Good Manufacturing Practices and demonstrating their safety and efficacy under FDA Investigational New Drug (IND) applications. Work is managed by the U.S. Army Medical Research and Materiel Command. The Army is the lead service for infectious disease research. This project 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 in this project is performed by the Walter Reed Army Institute of Research, Silver Spring, MD and its overseas laboratories; U. S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; and the Naval Medical Research Center, Silver Spring, MD and its overseas laboratories.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Malaria Vaccines - In FY04, conducted FDA Phase 1 and Phase 2 trials of several candidate malaria vaccine components such as Merozoite Surface Protein–1 and membrane antigen–1 with the goal of defining the vaccine technology and components for broadly protective malaria vaccine. In FY05, test malaria blood stage vaccine components for integration into lead malaria vaccine candidate; and continue clinical testing of promising malaria vaccine components including additional preventive liver stage candidate antigens. In FY06, will continue Phase 1 and Phase 2 clinical testing of several promising malaria vaccine components. In FY07, will conduct Phase 1 human clinical trial with candidate multicomponent vaccines; start Phase 2 clinical trial of multicomponent vaccines; and establish partnership with industry for manufacturing of multicomponent vaccine for advanced clinical trial and future FDA licensure.	4620	5075	5416	5936
Diarrheal Vaccines - In FY04, successfully completed initial Phase 1 clinical trials for Shigella (S.) sonnei and dysentrie vaccines. Started Phase 1 clinical studies of Campylobacter vaccines. In FY05, continue clinical testing of lead Campylobacter vaccine; conduct Phase 1 clinical trials of one component of multiagent Shigella vaccine and a new subunit vaccine concept S. flexneri 2a (Invaplex). Conduct a Phase 2 clinical trial of encapsuled ETEC vaccine. In FY06, will complete a Phase 2 clinical trial with Campylobacter vaccine. In FY07, will conduct Phase 2 clinical trial with Invaplex as intranasal vaccine. Will prepare improved ETEC vaccine for Phase 1 clinical trial.	4473	3628	4304	4847
Dengue, Meningitis and Hemorrhagic Fever with Renal Syndrome (HFRS) Vaccines - In FY04, completed pre-Phase 1 clinical trial submissions and product manufacture of dengue DNA and HFRS vaccines. Completed preclinical testing and prepared for clinical studies of a monovalent group B meningococcal vaccine. In FY05, begin preclinical testing of new molecularly modified dengue virus and tetravalent DNA vaccine candidates. Conduct Phase 1 and start Phase 2 testing of HFRS vaccine. In FY06, will conduct additional clinical testing of best dengue vaccine candidates. Continue clinical testing of HFRS to demonstrate safety; and begin clinical testing for new group B meningococcal vaccine. In FY07, will start Phase 1 clinical trial of a multivalent (active against several strains of an organism) vaccine group B vaccine; and continue critical Phase 2 testing of HFRS and dengue vaccines.	4342	4251	4084	4638

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Antimalarial Drug Candidates - In FY04, completed all FDA-required preclinical toxicity testing of Artesunate and submitted application for Phase 1 clinical testing; moved new candidate drugs for prevention of malaria into preclinical testing and down-selected best candidate for clinical testing. In FY05, complete Phase 1 a, b, and c clinical testing of Artesunate. Continue to test new drugs to prevent malaria and select best candidates for clinical trials. In FY06, will complete most Phase 2 clinical testing of Artesunate, a promising new malaria drug. In FY07, will complete clinical testing of Artesunate and submit New Drug Application to FDA.	2398	3055	3502	3646
Insect Vector Control and Infectious Disease Diagnostics - Insect Vector Control and Infectious Disease Diagnostics - In FY04, defined components and tested Dengue Vector Control System (DVCS) components at multiple field sites; identified critical infectious disease diagnostic components for use in a joint services biological agent identification and diagnostic system; evaluated candidate leishmania diagnostics tests for rapid fielding. Began sand fly vector control testing and evaluation. In FY05, continue component product improvements and assess potential point of care and hospital-based infectious disease diagnostics systems including malaria. In FY06, will transition the DVCS components into the next phase of development and assess leishmania diagnostic system; and will develop approaches to supplement infectious disease diagnostics not compatible with joint diagnostic system. Will continue sand fly vector control component testing and evaluation. In FY07, will initiate comprehensive field-testing of sand fly control measures and transition to the Preventive Medicine Detachment tool kit. Will continue to provide additional diagnostic sets for integration into Joint Biological Agent Identification and Diagnostic System and point of care diagnostic sets for testing.	2879	615	1947	1798
Totals	18712	16624	19253	20865

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
819	FLD MED PROT/HUM PERF	1397	1324	1126	1179	1220	1259	1295	1330

A. Mission Description and Budget Item Justification: This project 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 and physiological stressors and materiel hazards in training and operational environments. Major efforts include chemical and bacterial hazard identification and risk assessment methods. This research matures development of tools for assessing weapon system user health risks, diagnostic tools and treatments for laser eye injuries on the battlefield, injury prediction tools for assessing soldier survivability, effective individual protective equipment, assessments concerning drugs to sustain soldier performance during continuous operations, and tools for assessing health risks to soldiers in operational 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). Work in this project is performed by the Walter Reed Army Institute of Research, Silver Spring, MD and the U.S. Army Institute of Chemical Defense, Aberdeen, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Chemical & Bacterial Hazard Research - In FY04, the Environmental Protection Agency validated the nucleic acid-based coliform bacterial detection system that can protect drinking water supplies by detecting the viability (live or dead) of coliform bacteria. In FY05, develop methods using gene micro-array technologies to identify biomarkers that indicate exposure to militarily relevant chemical hazards. In FY06, will conduct test using laboratory animals and select biomarkers that indicate chemical exposure. In FY07, will identify potential human biomarkers through extrapolation of animal data.	1397	1324	1126	1179
Totals	1397	1324	1126	1179

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
840	COMBAT INJURY MGMT	15479	12362	19502	22255	29921	26660	26911	27131

A. Mission Description and Budget Item Justification: This project matures and demonstrates new medical technologies in support of the Future Force. Major efforts include: hemorrhage control, blood and resuscitative fluids discovery and development; combat trauma therapies; far-forward medical systems (including diagnostic and therapeutic medical devices) development; and combat casualty care bioinformatics and simulation development. Included are new candidate intravenous clotting drugs; advanced technologies for treating extremity injuries to bone and flesh; freeze-dried plasma to treat hemorrhage and further reduce the medical footprint; neuroprotective drugs to minimize consequences of head injury; preventive dental care technologies including peptides to fight dental disease; and remote triage technologies designed to maximize field medic resources. The "Warrior Medic," a promising Future Force medical technology capabilities, will enable the combat medic to rapidly assess casualty vital signs and link to other physiological monitors. Other key technologies funded include: new and advanced resuscitation fluids and strategies for combat medic administration that improve survival of casualties with severe blood loss (shock) on the battlefield; an automated assisted critical care system for enhanced management, transport, and survival of stabilized casualties far-forward, within and outside of the battle area; and a handheld system employing acoustic energy to control internal hemorrhage for forward use at the battalion aid station. Selected technologies are integrated into Medical Mission Packages incrementally to provide comprehensive far-forward treatment for the Future Force. All research is conducted in compliance with 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 U.S. Army Institute of Surgical Research, Fort Sam Houston, TX, U.S. Army Research Institute of Environmental Medicine, Natick, MA, and the Walter Reed Army Institute of Research, Silver Spring, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Hemorrhage Control, Blood and Resuscitative Fluids - including discovery and development of drugs, biologicals, and medical procedures to prevent or minimize secondary organ system injury and failure (including brain and spinal cord injury) after major trauma. In FY04, studied the effectiveness of candidate hemorrhage control agents (gel, foam, liquid), drugs, and high intensity focused ultrasound in controlling severe internal bleeding; conducted studies of candidate packaging systems for freeze-dried blood products that will enhance delivery and storage of blood products in the field; conducted clinical studies to select the best commercially available resuscitation fluid(s); evaluated the maximum tolerable delay in administration of resuscitation fluids. In FY05, conduct studies in animals of a handheld device that stops bleeding with sound waves for use at the battalion aid station; study in animals the effectiveness of candidate drugs and agents to enhance blood clotting and restore normal blood clotting; conduct clinical studies of freeze-dried plasma; finalize guidelines for the optimum resuscitation strategy; conduct studies of oxygen transport and free radical scavenging fluids; conduct investigation of inhibiting complement activation as a method of reducing tissue damage associated with shock. In FY06, will complete animal studies and sample analyses from coagulation studies; will conclude comparative studies of resuscitation fluids; will test FDA-approved complement inhibitors in small animals to determine their safety; refine model for assessing resuscitation requirements. In FY07, will complete data analyses from coagulation studies; will recommend best new fluid for resuscitation; and will select the most promising complement activation inhibitor and introduce into clinical trials; will complete guidelines for resuscitation and evacuation of head-injured patients.	6116	4509	9439	13090

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Combat Trauma Therapies - including discovery of drugs, biologicals, and medical procedures to minimize the immediate and long term effects from battlefield injuries. In FY04, completed Phase 2 clinical trials to replace morphine on the battlefield with a nasally administered Ketamine that does not impair cognitive performance; transitioned advanced tourniquet use guidelines to the Army Medical Department Center and School; transitioned three candidate one-handed tourniquets to advanced development; evaluated a wound-protectant device and an improved tourniquet device in animals; conducted proof-of-concept studies of a small antimicrobial wound-cleaning device; conducted proof-of-concept studies of lightweight materials and splints for fracture stabilization; completed maturation of a new penetrating head injury (PHI) model; identified a lead drug-development candidate for the treatment of acute, early brain seizures arising from traumatic brain injuries. In FY05, commence Phase 3 clinical trial of Ketamine in relevant models and quantify effects as compared to Morphine; conduct Phase 1 clinical tests of an improved tourniquet; mature and demonstrate wound-cleaning devices, antimicrobial bone graft substitutes and lightweight materials for splints; mature prototype of device to assess tissue viability. Conduct neuroprotection drug studies in the PHI model to identify a drug to improve survival and residual brain function in casualties with brain injury; conduct studies to determine if resuscitation requirements are altered after traumatic brain injury. In FY06, will transition long bone splint to advanced development; and select best bone substitute. In FY07, will begin human clinical trials of tissue viability assessment device; will transition best bone substitute material to advanced development; and will use the PHI model in further studies to evaluate the body's response mechanism to this type of injury.	3689	2509	4023	3051

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
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. In FY04, adapted micro-impulse radar (MIR) monitor into a wearable prototype for continuous monitoring through soldier clothing; selected a set of sensors that detect ballistic wounding and life signs that are integrated with hydration, and sleep status sensors. In FY05, complete maturation of formulation and application methodology of an anticavity/antiplaque food additive to prevent dental disease; transition handheld MIR vital signs monitor to System Development and Demonstration; complete algorithms for detection of ballistic wounding, life signs, hydration and sleep status in the prototype Future Force Warrior ensemble; complete human trials of a fieldable acoustic collapsed lung detector; demonstrate proof of concept of closed loop oxygen and ventilation delivery system and start on fluid infusion system. In FY06, will complete integration of the sensor suite, and generate algorithms with the Personal Area Network; will complete integration of the initial capability with Future Force Warrior Advanced Technology Demonstration; will evaluate relationships among variables that signal cardiovascular collapse and indicate the need to apply a Life Saving Intervention (LSI); will demonstrate effectiveness of closed loop oxygen and ventilation control and fluid resuscitation systems; and complete formulation of antimicrobial delivery vehicle for prevention of dental disease. In FY07, will complete analysis of data to obtain algorithms for prediction of cardiovascular collapse and indicate the need to apply a LSI; will complete clinical validation of closed loop fluid infusion system; will evaluate neuroprotective drugs for reduction of morbidity following burn injury; and establish antimicrobial activity profiles in animals for prevention	4084	4425	4570	5423

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Combat Casualty Bioinformatics and Simulation - including a far-forward-compatible system for creation and management of patient records and theater regulation of patient flow and development of casualty simulations and durable, realistic simulators for initial and reinforcement training of care providers. In FY04, in conjunction with Research Development and Engineering Command, matured a methodology to support combat medic training in a highly distributed environment, including treatment of patients exposed to chemical, biological, and nuclear weapons. In FY05, complete a prototype patient simulator with advances in materiel sciences, including realistic skin and physiologically accurate injuries, sensor technologies, miniaturization/packaging technology and ad hoc wireless networking. In FY06, will complete testing the system to assess training effectiveness for transition to the Army Medical Department Center and School. In FY07, will deliver a deployable, untethered, robust, self-correcting, self-assessing medical simulation training system for far-forward care providers.	1590	919	1470	691
Totals	15479	12362	19502	22255

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

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

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FH4	FORCE HEALTH PROTECTION - ADV TECH DEV	0	0	1936	2114	2148	2190	2233	2277

A. Mission Description and Budget Item Justification: Force Health Protection Research seeks to enhance protection of Service members against health threats in military deployments both by increasing our understanding of military health issues through advanced technology research and by applying findings from a decade of research on the etiology (cause and origin of disease) and treatment of Gulf War Illnesses (GWI). This program is conducted in close coordination with the Department of Veterans Affairs. The program is divided into five thrust areas: (1) global health monitoring, (2) health behavior interventions, (3) health risk communication, (4) health risk assessment methods, and (5) medical materiel safety. This project 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 in this project is performed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA; the Naval Health Research Center, San Diego, CA; and the U.S. Army Center for Environmental Health Research, Fort Detrick, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY06, will demonstrate the cross-linkage between physical activity, weight management and healthy lifestyle to assess research findings and linkages to symptoms identified in these activities to the condition described as “chronic multi-symptom illness.” In FY07, will determine the effectiveness of current and state-of-the-art programs for healthy lifestyles (tobacco cessation and preventing alcohol abuse) in the military environment to assess research findings linking these approaches to the condition described as chronic multi-symptom illness.	0	0	1936	2114
Totals	0	0	1936	2114

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603003A - AVIATION ADVANCED TECHNOLOGY

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	73072	96465	48318	67154	93010	101133	108067	103719
313	ADV ROTARYWING VEH TECH	43737	50659	34828	53022	63819	64973	69717	65460
435	AIRCRAFT WEAPONS	937	3881	3916	3215	4077	4969	4877	4972
436	ROTARYWING MEP INTEG	4672	5618	1921	2841	16654	22606	23714	23165
447	ACFT DEMO ENGINES	6652	6877	7653	8076	8460	8585	9759	10122
B97	A/C AVIONICS EQUIPMENT	4329	0	0	0	0	0	0	0
BA7	AVIATION ADVANCED TECHNOLOGY INITIATIVES (CA)	7783	25692	0	0	0	0	0	0
BA8	VECTORED THRUST DUCTED PROPELLER (CA)	4962	3738	0	0	0	0	0	0

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 Joint Vision 2020, and, where feasible, exploits opportunities to enhance Current Force capabilities. Based on the Army Transformation, this PE investigates technologies applicable to all aviation systems, both manned and unmanned, while providing opportunities for technology insertion into the Current Force systems. Unmanned rotary wing vehicles bring unprecedented agility, maneuverability, and lethality to the Future Force while providing improved survivability and reduced sustainment costs. Within this PE, aviation technologies will be matured and integrated into realistic and robust demonstrations. Emphasis will be placed on maturing manned and unmanned teaming in combat and combat support operations for attack, reconnaissance, air assault, survivability, and command and control missions. Components and subsystems that enable increased system survivability, platform lift, maneuverability, agility, and endurance; autonomous flight; common mission equipment architecture; full spectrum effects; team-based intelligent mission operations; and manned / unmanned battlespace integration will be demonstrated. Major efforts within this PE include the A-160 Hummingbird component maturation and flight demonstrations; manned-unmanned system teaming demonstrations; manned-unmanned common architecture maturation; joint heavy lift concept exploration and 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. Projects B97, BA7, and BA8 fund Congressional interest items. Upgrade activities of Department of Defense (DoD) systems such as the AH-64 Apache, UH-60 Black Hawk, CH-47 Chinook; the U.S. Navy SH-60 Seahawk; and U.S. Marine Corps V-22 Osprey, AH-1 Cobra and CH-53 Super Stallion are supported 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 Applied Technology Directorate of the Aviation and Missile Research, Development and Engineering Center located at Fort Eustis, VA.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	69549	90566	106966
Current Budget (FY 2006/2007 PB)	96465	48318	67154
Total Adjustments	26916	-42248	-39812
Net of Program/Database Changes			
Congressional Program Reductions	-1123		
Congressional Rescissions			
Congressional Increases	30700		
Reprogrammings			
SBIR/STTR Transfer	-2661		
Adjustments to Budget Years		-42248	-39812

Change Summary Explanation:
FY06 - Funds realigned ($42248K) to higher priority requirements.
FY07 - Funds realigned ($39812K) to higher priority requirements.

Eight FY05 Congressional adds totaling $30700 were added to this PE.

FY05 Congressional Adds with no R-2A:
($5754) Excaliber Tact UCAV, Project BA7: The purpose of this one year Congressional add is to fund research on the Excaliber Tact UCAV.

No additional funds are required to complete this project.

($2876) Locust USA Heavy Fuel Burning Engines for UAVs, Project BA7: The purpose of this one year Congressional add is to mature a small heavy fuel engine for UAV application and to further address scalability of the design. No additional funding is required to complete this project.

($5754) Process Technologies for Replacement Part Production, Project BA7: The purpose of this one year Congressional add is to fund research on process technologies for replacement part production.

($1247) Reconfiguration Tooling System, Project BA7: The purpose of this one year Congressional add is to demonstrate a reconfigurable tooling system capable of delivering a complete composite repair system that incorporates tool creation and composite curing for rapid repair and replacement of mission critical parts at the depot level. No additional funding is required to complete this project.

($4700) UAV and Micro Air Vehicle Dynamometer, Project BA7: The purpose of this one year Congressional add is to modify the current air dynamometer designs to enable testing of UAV engines on the Army's existing equipment and to explore alternative compression systems for dynamometer / engine applications. No additional funding is required to complete this project.

($3739) Vectored Thrust Ducted Propeller (VTDP) Compound Helicopter Program, Project BA8: The purpose of this one year Congressional add is to assess the potential for a VTDP helicopter to improve the speed, range and survivability of a UH-60 Black Hawk helicopter while reducing ownership cost. No additional funding is required to complete this project.

($4123) Wideband Network Enhancement for Joint Ground Force Interoperability, Project BA7: The purpose of this one year Congressional add is to fund research on a wideband network enhancement for joint ground force interoperability. No additional funds are required to complete this project.

($1247) Wiring Traceout for Joint Aviation Technical Data Integration, Project BA7: The purpose of this one year Congressional add is to fund research on a wiring traceout for joint aviation technical data integration. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**	**313**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
313	ADV ROTARYWING VEH TECH	43737	50659	34828	53022	63819	64973	69717	65460

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. It is envisioned that the Future Force will require 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 demonstration of prototype UAVs, rotors, active controls, structures, drive-train, integrated architecture and threat protection. The near-term demonstration of VTOL UAVs will focus on the A-160 Hummingbird for Reconnaissance, Surveillance and Target Acquisition (RSTA) capability. The A-160 Hummingbird program is a collaborative effort between the Army, the Defense Advanced Research Projects Agency (DARPA), and the U.S. Special Operations Command. These demonstrations will focus on military operations and achieving military specifications for these maturing systems. The integration of technology into UAV and manned teaming operations will be demonstrated through the merging of common operating architecture and team survivability. The Manned Unmanned Common Architecture Program (MCAP) will enable the manned and unmanned teams to use low cost modular, commercial-off-the-shelf electronics and open systems interface standards for advanced mission processing. The Survivable, Affordable, Reparable Airframe Program (SARAP) will reduce weight and increase the survivability for both manned and unmanned systems. The Rotorcraft Drive Systems for the 21st Century (RDS21) program will provide a 35% increase in power-to-weight ratio, 20% reduction in both production and Operating and Support (O&S) costs and a 12 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 will enable a 40% increase in payload for the AH-64 Apache, a 20% increase in range for the UH-60 Black Hawk, and over a 25% increase in range for the CH-47 Chinook. The Active/Passive Aircraft Survivability program will reduce infrared signatures by up to 75%, incorporate innovative directional IR jamming, small arms and RPG hostile fire warning, threat location cueing and eye-safe visual dazzler components to improve aircraft survivability by at least 50% against small arms, RPG and MANPADS threats. This project also supports Concept Exploration of a Joint Heavy Lift platform. This effort will assess the technologies and system design trades to enable FCS vertical maneuver and Naval sea-basing. 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 2004	FY 2005	FY 2006	FY 2007
Integrated UAV Operations – [Includes the Airborne Manned Unmanned System Technology (AMUST), the Manned Unmanned Common Architecture Program (MCAP), and the Unmanned Autonomous Collaborative Operations (UACO) program] - AMUST: In FY04, completed detailed decision aiding and UAV control designs on both the AH-64D Longbow Apache and Army Airborne Command and Control System (A2C2S) UH-60 Black Hawk. Completed development of UAV control capability in both aircraft and conduct flight tests. MCAP: In FY04, completed detailed architecture designs on the AH-64D Longbow Apache. Initiated system level demonstrations of common architecture between manned and unmanned rotorcraft. Conducted flight tests and performed data analysis and published systems architecture documentation. In FY05, complete software development environment, mission processing architecture, avionics integration laboratory at the contractor facility, on-aircraft ground tests, and flight tests on an AH-64D Apache Longbow. Conduct laboratory tests of the unmanned air vehicle embedded mission processing architecture in a Shadow 200 and complete software architecture design and development. In FY06, will publish final architecture design documentation. UACO: In FY04, completed Concept Definition study for Class II UAVs and UGVs to support cooperative engagement. In FY05, award UACO contract and begin development of advanced autonomy and collaboration algorithms for UAVs. Design demonstration system and integrate and test mission equipment hardware and autonomy/collaboration enabling software. In FY06, will complete development of UAV advanced autonomy and collaboration algorithms. Will also complete Control Stations and Vehicle Systems integration, checkout and preliminary flight evaluation. In FY07, will complete final demonstration of Air-Ground Cooperative Engagement using multiple autonomous UAVs and UGVs at the McKenna MOUT site.	12891	7585	6135	1874

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
A-160 Hummingbird - In FY04, conducted system flight-testing to test-fix-test airframe and components at gross weights up to 4,000 pounds and altitudes up to 5,000 feet. Conducted component level environmental testing. Reviewed A-160 flight test results, including initial mission equipment package (MEP) integration with electro optical and infrared (EO/IR) sub-systems. Validated A-160 baseline configuration and capabilities by showing results are consistent with performance predictions. In FY05, conduct A-160 continuous air vehicle system flight tests at gross weights up to 5,000 pounds, altitudes up to 20,000 feet, and up to 100% rotor speeds. Integrate Commercial-Off-The-Shelf turbine engine. Refine the A-160 Ground Control Station, airframe and mission equipment packages, to include EO/IR flight demonstrations with up to four A-160 vehicles. Define parameters for increased system and airframe autonomy. Investigate A-160 flight and performance parameters through full scale wind tunnel testing and evaluation. Validate that A-160 revised configuration and capabilities meets performance predictions. Testing will include approximately 600 flight test hours. In FY06, will expand A-160 flight envelope and improve vehicle reliability, with flights of 10-20 hours in duration at an increased operational tempo (OPTEMPO). Will demonstrate flight with turbine engine; establish a baseline configuration for Army user; refine and integrate existing design; and conduct extensive flight tests using A-160 Ground Control Station. Testing will include approximately 700 flight test hours. In FY07, will fly A-160 vehicle in OPTEMPO consistent with goals of 3 flights per week with of about 8 hours per flight. Will conduct flights over 20 hours endurance. Will conduct extensive flight-testing of Army baseline model and multiple vehicles under single ground station control. Will demonstrate representative MEP. Testing will include approximately 700 flight test hours.	10000	22829	17193	34768
Active / Passive Aircraft Survivability program - In FY05, design and ground demonstrate, on a full-scale engine test stand, an adaptive IR suppressor system that reduces engine signatures by 75% while providing an additional 3% increase in engine performance relative to current IR suppressor systems. A 3% power increase on an AH-64 Apache helicopter translates into approximately 530 lbs of additional lift capability. In FY06, will integrate and demonstrate adaptive IR suppressors, super lightweight thermal insulation and multi-spectral coatings to achieve up to 75% reduction in total aircraft IR signature. In FY07, will design and flight demonstrate an integrated hostile fire warning, visual cueing and visual dazzler system that reduces small arms and RPG pointing accuracy by 50%.	0	2000	4500	8000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Rotorcraft Structures [Includes the Survivable, Affordable Repairable Airframe Program (SARAP)] - In FY04, conducted major effort of SARAP with manned and unmanned rotary-wing virtual prototype models and simulations. Implemented predictive risk management process to select highest payoff technologies for full-scale development and demonstration. Validated probabilistic building block qualification methodology. Modeled and simulated ballistic and rocket propelled grenade (RPG) threats and structure vulnerability. In FY05, fabricate virtual prototype (full digital definition and simulations/models) validation hardware for ballistic, static, and crash testing. Validate manned and unmanned virtual prototype models and simulations with full-scale hardware fabrication and test to improve weight, cost, supportability, and survivability. Conduct full-scale hardware ballistic, static, fatigue, and crash testing to validate virtual prototype models and simulations. In FY06, will transition SARAP structural technologies, concepts, and methodologies to current and developmental manned and unmanned rotary wing systems such as UH-60 Black Hawk, CH-47 Chinook, CH-53 Super Stallion, and A-160 Hummingbird.	9891	4193	1000	0
Drive Train [Includes the Rotorcraft Drive System for the 21st Century (RDS21) program] - In FY04, fabricated full-scale test hardware and full-scale RDS21 split torque/face gear demonstration hardware and composite housing. Assembled gear box in preparation for goal demonstration. Conducted preliminary rig tests of component hardware and gears. In FY05, conduct goal demonstration testing (weight/durability/noise) of RDS21 demonstrator at two industry test sites. Complete design, advanced materials research and manufacturing techniques evaluation. Provide RDS21 technologies for potential integration onto AH-64D Apache Block III.	4955	6052	0	0
Drive Train [Includes the Enhanced Rotorcraft Drive System program] - In FY07, will develop baseline design of the Enhanced Rotorcraft Drive System applicable to the Joint Heavy Lift aircraft, as well as for upgrades to the Armed Reconnaissance Helicopter, UH-60 and the Mission Enhanced Little Bird, with goals of 40% increase in power to weight ratio, 15dB reduction in transmission noise, and 30% reduction in operating and sustainment costs.	0	0	0	2380
Slowed Rotor Demonstration. In FY04, demonstrated the principle of a slowed main rotor that is optimized for minimum drag, utilizing a vertical takeoff and landing gyro-copter.	1800	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Unmanned Combat Armed Rotorcraft (UCAR) - The UCAR program goal was to demonstrate an armed survivable VTOL UAV that could recognize dismounted infantry at >2 km; had a flyaway cost of $4-8M; and an operating and sustainment cost that was 20%-40% of Apache. Applied Research for UCAR was conducted in FY02 and FY03 within PE 0602211A Aviation Technology, at which point the effort transitioned into PE 0603003A. In FY04, completed UCAR Phase II, Preliminary Design. Industry teams identified best technical approaches considering mission effectiveness, lethality, system performance, autonomous operations, and command and control. Program was terminated upon completion of Phase II due to higher priorities.	4200	0	0	0
Joint Heavy Lift (JHL) - In FY05, will initiate Joint Concept of Operations Refinement and Aerial System Concept Design Analysis. Formulate Joint Integrated Product Teams for programmatic, technology, and requirements support. Will award up to four contracts to industry to explore design concepts. In FY06, will develop initial concept designs and assess performance characteristics relative to evolving joint requirements. Initiate a Joint Analysis of Alternatives (AoA). In FY07, will complete Concept Design Analysis and Configuration Assessments. Will complete the Joint AoA and develop a draft Capabilities Development Document.	0	8000	6000	6000
Totals	43737	50659	34828	53022

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**	**435**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
435	AIRCRAFT WEAPONS	937	3881	3916	3215	4077	4969	4877	4972

A. Mission Description and Budget Item Justification: The Aircraft Weapons project matures 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 supports the Future Force and Joint Vision 2020 by providing mature technologies to focus combat power on multiple targets. The technologies will 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 system 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 2004	FY 2005	FY 2006	FY 2007
Weapons Integration. [Includes the Aerial Delivery of Effects from Lightweight Aircraft (ADELA) program] - In FY04, provided support to Hunter Standoff Killer Team Advanced Concept Technology Demonstration to mature an Integrated Operational Picture system architecture for actively tasking sensor platforms and weapons. In FY05, initiate the Unmanned Light Armed Reconnaissance Testbed (ULART) program that leverages industry to convert a small helicopter into a robust VTOL UAV testbed with robust weapons potential and an on-board safety pilot as a safety backup. The ULART program will investigate: precision targeting and weapons delivery, limited coupling of weapon systems with vehicle management, understanding operator weapons interface issues, and manned/unmanned aircraft teaming. In FY06, ULART will investigate unmanned teaming and cueing for collaborative engagements and demonstrate integration of a variety of existing low-cost, lightweight sensors and weapons on small UAV platforms to aid in the delivery of full spectrum of effects in complex terrain under close support conditions. In FY07, will demonstrate tactical fire control, team situational awareness, modular weapon and sensor payloads, human-in-the-loop protocols and collaborative, teams-based weapons and precision targeting processes to demonstrate a Revenge Kill capability on small UAV platforms.	937	3881	3916	3215
Totals	937	3881	3916	3215

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**	**436**

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
436 ROTARYWING MEP INTEG	4672	5618	1921	2841	16654	22606	23714	23165

A. Mission Description and Budget Item Justification: The Rotary Wing Mission Equipment Package Integration project matures and validates man-machine integration and mission equipment technologies in support of the Future Force, and, where feasible, exploits opportunities to enhance Current Force capabilities. This project improves the overall mission execution by demonstrating manned and unmanned system teaming, enhanced helicopter pilotage capability and improved crew workload distribution. This project supports the Future Force and Joint Vision 2020 by providing mature technology to enhance near-real time situational awareness for manned and unmanned rotary wing vehicles. This project supports the completion of the Hunter Standoff Killer Team through the Airborne Manned and Unmanned System Technology program that provides intelligent software and integrates advanced technologies in sensors, displays, communication and controls necessary to team airborne manned and unmanned vehicles to maximize the teams' lethality, survivability, and operational tempo in support of the maneuver commander. The manned / unmanned team will be capable of performing reconnaissance, surveillance, target acquisition and attack while maintaining constant tactical situation awareness. Integration of state-of-the-art approaches in artificial intelligence, intelligent agents, sensors, avionics, communications, pilot vehicle interfaces, and autonomous assistants will enable a manned-unmanned team that enhances Army aviation battlefield effectiveness. This project provides Cognitive Decision Aiding (CDA) tools for crews by maturing knowledge-based information systems. Advanced integration technology in information management, sensors, displays, and controls is optimized for combat helicopter mission effectiveness and survivability for day / night adverse weather operations. Virtual prototyping capability is used as the foundation for evaluating combined rotorcraft control and crew performance. 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 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 2004	FY 2005	FY 2006	FY 2007
Airborne Manned and Unmanned System Technology (AMUST) [Includes the Hunter Standoff Killer Team (HSKT) Advanced Concepts Technology Demonstration (ACTD)] - In FY04, matured system architecture for actively tasking UAV sensor platforms and systems from manned aircraft that supports targeting and situation awareness among commanders and warfighters. In FY05, conduct operational demonstration of AMUST/HSKT system on AH-64D Longbow Apache, Army Airborne Command & Control System (A2C2S) Black Hawk, and Hunter UAV. Mature tactics, techniques and procedures in simulation to formulate a sensor-to-shooter solution for time-critical targets at desired sensor resolution.	3709	5618	0	0
Networked UAV System Demonstration - This program captures the results of the AMUST and Unmanned Autonomous Collaborative Operation (UACO) program. In FY06, will lay the groundwork for a coordinated flight demonstration program for the integration of multiple S&T tools developed under several separate Army Technology Objectives (ATOs). Will evaluate component technologies from decision aiding, autonomy, collaboration, networking, and architecture technologies from Rotorcraft Pilots Associate, Hunter Standoff Killer Team/Airborne Manned Unmanned System Technology-Demonstration, UACO, Manned Unmanned Common Architecture Picture, Survivability Planner Associate Re-router, Aerial Delivery of Effects from Lightweight Aircraft, Joint Architecture for Unmanned Systems, and Air Force Research Laboratory/Naval Research Laboratory/Defense Advanced Research Projects Agency/industry/academia efforts. Will determine, in terms of maturation and benefit, potential for application to UAVs and manned aircraft. Will formulate acquisition strategy, enter agreements with other Government agencies/industry/academia as appropriate. Will coordinate with The Technical Cooperation Program for coalition co-operation opportunities for UAV demonstration of operation with manned air and ground systems. Will prepare Request for Proposals and evaluate proposals. In FY07, will award contract(s) and begin development of decision aiding, collaboration, and networking technologies and architectures for application to manned helicopters and autonomy, collaboration, networking technologies and architectures for application to UAVs.	0	0	1921	2841
Airborne Manned/Unmmanned Systems Technology (AMUST) - This one year Congressional Add completed the development and testing of the RF network for the AMUST program. No additional funding is required to complete this project	963	0	0	0
Totals	4672	5618	1921	2841

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603003A - AVIATION ADVANCED TECHNOLOGY**	**447**

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
447 ACFT DEMO ENGINES	6652	6877	7653	8076	8460	8585	9759	10122

A. Mission Description and Budget Item Justification: The Aircraft Demonstration Engines project matures 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 and Joint Vision 2020 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. This will improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. The Small Heavy Fuel Engine (SHFE) program is fully coordinated / aligned with the phases / goals of the Department of Defense (DoD) Versatile Advanced Affordable 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 provides significantly increased range and payload capabilities for future manned and unmanned rotorcraft and sustainment upgrades for current engines. This will include significant Operation and Support cost savings and a significantly reduced logistics footprint. The SHFE program is focusing on maturing and demonstrating advanced, affordable turbine engine technology in the 700 horsepower (HP) class engine. 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 A-160 Hummingbird, AH/MH-6 Mission Enhanced Little Bird, FireScout Unmanned Aerial Vehicle, and Future Combat Systems (FCS) ground and aerial 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 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 2004	FY 2005	FY 2006	FY 2007
Joint Turbine Advanced Gas Generator (JTAGG) and Integrated High Performance Turbine Engine Technology (IHPTET) - In FY04, completed fabrication of test hardware and performed integrated engine component demonstration for program goal achievement.	200	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Small Heavy Fuel Turbine Engine (SHFE) - In FY04, began SHFE program with a goal to demonstrate a 700 HP engine with: 20% reduction in specific fuel consumption (SFC), 50% increase in HP to weight ratio, and 35% cost reduction. Program will use sequential design and fabrication iterations to mature demonstrator. Began engine component fabrication to support rig tests and full engine demonstration. In FY05, procure parts, build and rig test components of 700 HP engine, including the combustor, mechanical components, spin validation, and turbine validation. Complete Build 1A core testing and Build 1B engine testing. In FY06, will incorporate design improvements of the compressor, combustor, and power turbines, mechanical components, and control and accessories into Builds 2 and 3. Will complete the fabrication of redesigned components for engine Build 2. Will conduct rig test on redesigned combustor and mechanical systems. In FY07, will complete engine testing of Build 2 and rig test optimized components. Will complete the fabrication of components for engine Build 3. Will conduct final engine test for Build 3 to demonstrate program goal achievement.	6452	6877	7653	8076
Totals	6652	6877	7653	8076

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	52305	83337	74927	80632	77033	90524	90088	98748
232	ADVANCED MUNITIONS DEM	26990	46213	47315	50776	39042	43869	39363	37894
43A	ADV WEAPONRY TECH DEMO	6469	16956	0	0	0	0	0	0
L94	ELECTRIC GUN SYS DEMO	18846	19210	18612	14721	17118	19985	24703	32203
L96	HIGH ENERGY LASER TECHNOLOGY DEMO	0	958	8000	14115	19852	25649	25001	27630
L97	SMOKE AND OBSCURANTS ADVANCED TECHNOLOGY	0	0	1000	1020	1021	1021	1021	1021

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 Combat Systems (FCS), the Future Force and, where possible, the Current Force. The general goal of this program is to provide the warfighter with weapons and munitions that provide equivalent or greater lethality (or other desired effects) when compared to current weapon systems - at greater ranges, with greater precision, in lighter weight systems and at affordable costs. Project 232 funds the munitions development efforts associated with the FCS 120mm Line Of Sight (LOS)/Beyond Line Of Sight (BLOS) System Advanced Technology Demonstration (ATD), which is completing in FY05 and will provide the main armament, a lightweight cannon and associated ammunition for the FCS Mounted Combat System (MCS). Although this ATD focused on developing a 120mm solution, the technologies and designs being pursued are applicable to either a 120mm or 105mm lightweight gun system, whichever becomes the final MCS design. Project 232 also funds Mid Range Munition (MRM), which is the round that will enable the MCS to have an extended range (BLOS) capability; MCS Ammunition System Technologies (MAST), which will provide enhanced capabilities beyond the baseline LOS/BLOS armament and munition suite; Objective Non-Line Of Sight (NLOS) Mortar Technology, which will demonstrate a 120mm breech loaded recoiling mortar for under armor application; Common Smart Submunition, which will develop and demonstrate component technologies for a next generation precision kill and target-discriminating submunition that can be used in a variety of delivery systems; and Non-Lethal Payloads for Personnel Suppression and Vehicle Area Denial, which will design and demonstrate the munitions to surpress activity or deny access to designated areas. 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 FY06. Based on successful completion of the component technologies, the Army will begin an ATD in FY07 for the design, fabrication and test of a full-scale, medium caliber EM armament demonstrator with robust LOS capability. EM Gun has the potential to revolutionize the future battlefield by its unique performance characteristics, including hypervelocity lethality effects and greatly reduced logistics burden. In FY06 a new project, L96, will be initiated with the goal of maturing and demonstrating a high energy solid-state laser weapon. In FY05 funding for a new project, L97, was realigned from PE 0602622A to mature and demonstrate smoke and obscurant technologies with the potential to enhance personnel and platform survivability. Work in projects 232, 43A and L94 is related to, and fully coordinated with, efforts in PE 0602624A (Weapons and Munitions Technology), PE 0602618A (Ballistics Techology), PE 0604802A (Weapons and Munitions - Engineering Development), and PE 0602307A (Advanced Weapons Technology).

Work in this PE associated with Project L96 is related to, and fully coordinated with, efforts in PE 0605605A (DOD High Energy Laser Systems Test Facility), and starting in FY03 PE 0603305A/TR3 (Army Missile Defense Systems Integration/Mobile Tactical High Energy Laser), PE 0603005A/441 (Pulse Power for FCS), and to 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 Project A552 (Smoke/Novel Obscurant Munitions). 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).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	67622	74572	61701
Current Budget (FY 2006/2007 PB)	83337	74927	80632
Total Adjustments	15715	355	18931
Net of Program/Database Changes			
Congressional Program Reductions	-1548		
Congressional Rescissions			
Congressional Increases	19550		
Reprogrammings			
SBIR/STTR Transfer	-2287		
Adjustments to Budget Years		355	18931

Change Summary Explanation:
FY07 - Increased Funding ($18391) supports Electric Gun System Demonstrations and Mid Range Munitions (MRM) development.

Nine FY05 Congressional adds totaling $19550 were added to this PE.

FY05 Congressional Adds with no R-2A:
($2018) Compressor Blades Wear-Resistant Ceramic Coating, Project 43A: The purpose of this one year Congressional add is to fund research on a wear-resistant ceramic coating for compressor blades. No additional funding is required to complete this project.

($1346) Development Mission Integration, Project 43A: The purpose of this one year Congressional add is to provide demonstrations of integrated armament technologies for armament systems to include integration activities on surrogate ground/air platforms. No additional funding is required to complete this project.

($2355) Main Rotor and Anti-Torque Blade Erosion Resistant Ceramic Coating, Project 43A. The purpose of this one year Congressional add is to fund research on erosion resistant ceramic coatings for rotors. No additional funding is required to complete this project.

($960) Micro-Electromechanical System (MEMS) Reliability Assessment Program, Project 43A: The purpose of this one year Congressional add is to assess the reliability of MEMS devices. No additional funds are required to complete this project.

($5383) Rapid Prototyping for Special Projects, Project 43A: The purpose of this one year Congressional add is to fund research in rapid prototyping for special projects. No additional funding is required to complete this project.

($2114) Technology Demonstration for the Prevention of Material Degradation, Project 43A: The purpose of this one year Congressional add is to demonstrate technologies for the prevention or minimization of the effects of material degradation on Army materiel. No additional funds are required to complete this project.

($2691) Tungsten Penetrator, Project 43A: The purpose of this one year Congressional add is to fund research on a tungsten penetrator. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**232**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
232	ADVANCED MUNITIONS DEM	26990	46213	47315	50776	39042	43869	39363	37894

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. A major effort in this project is the FCS 120mm LOS/BLOS System ATD completing in FY05, which matures and demonstrates a lightweight cannon system with advanced recoil mechanism and lightweight materials to enhance range performance while driving down the overall system weight of the FCS Increment I Mounted Combat System (MCS). Although the ATD is focused on developing a 120mm solution, the technologies pursued are applicable to either a 120mm or 105mm lightweight gun system, whichever becomes the final MCS design. The Mid Range Munition (MRM), a gun launched precision munition for the MCS capable of defeating high-value heavy armor and other targets out to 8+km (i.e., for BLOS capability), is matured and demonstrated under the ATD and a MRM effort in FY06 and FY07. The MCS Ammunition System Technologies (MAST) effort will mature technologies to enhance the capabilities of the FCS armament system and munition suite for FCS spiral insertion or MCS upgrade. This project also funds Objective Non-Line Of Sight (NLOS) Mortar Technology, which will provide a 120mm breech loaded mortar (NLOS-M) with a design optimized for lightweight and thermal balance; Lightweight Dismounted Mortar Weapon, which is a man-transportable 81mm mortar fabricated from lightweight advanced materials and structures; Common Smart Submunition (CSS), which will pursue critical subsystem evaluations leading to final system demonstrations and offer increased operational efficiency through multiple kills per munition, afford greater flexibility for carrier applications, and enable utilization of a variety of delivery systems; Non Line of Sight Cannon (NLOS–C) Non Lethal Personnel Suppression, which will enable personnel suppression at BLOS ranges. . Rheostatic Pulsed Energy Weapons System (RPEWS) will demonstrate a DE weapon system exploiting advances in pulsed power supplies. This project also funds Active Protection System (APS) Launchers and Countermeasures for Lightweight Platforms, which will develop munitions and countermeasures for APSs on lightly armored, or very lightweight vehicles. 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, and the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
FCS 120mm LOS/BLOS System ATD: In FY04, successfully demonstrated two contractors' prototype MRM projectiles in an autonomous mode, BLOS guide-to-hit test, conducted at ambient temperature, to sense, maneuver and hit a target at 5km; conducted secondary armament turreted slew system demonstration and firing demonstration; completed firing demonstration of lightweight 120mm cannon with muzzle brake, blast deflector, and all turret interfaces required for integration into the FCS MCS turret. In FY05, complete design of integrated dual mode seeker for MRM; conduct multi-mode software development (target acquisition, seeker hand-off, tracking); perform Software-in-the-Loop, and Processor-in-the-Loop performance testing; fabricate components and assemblies and conduct high-g survivability testing; and fabricate prototype integrated dual mode seekers and conduct seeker performance testing (Tower/Captive Flight Test). In FY05 this technology will transition to PM Maneuver Armament Systems for System Development and Demonstration.	22940	16700	0	0
Mid Range Munition (MRM): In FY06, will conduct seeker performance testing (captive flight test and tower test) and procure components; will fabricate, assemble and demonstrate a gun-fired, designated-mode guided engagement vs. a BLOS target; will optimize software to improve tactical capabilities and conduct processor-in-the-loop and hardware-in-the-loop simulations for integrated dual mode seeker. In FY07, will procure components, fabricate and assemble prototypes, and complete a gun-fired, multi-mode BLOS demonstration with tactical performance capabilities.	0	0	10000	10000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
MAST: In FY05, complete fabrication, assembly and conduct subsystem air frame and warhead testing of Line Of Sight-Multi Purpose (LOS-MP) munition; integrate warhead and fuzing subsystems into airframe and demonstrate LOS-MP air burst capability for anti-personnel and effectiveness of penetrator and fuzing against concrete wall targets at government proving grounds; mature design, fabricate and conduct initial airframe testing at ambient temperature of Enhanced Kinetic Energy (KE) round. In FY06, will fabricate, assemble and conduct initial accuracy improvement testing for Enhanced KE; will demonstrate fracture resistant novel penetrator; procure material, complete fabrication and assembly and conduct testing of advanced propellant to determine hot performance characteristics across temperatures and of igniters for advanced propulsion systems. In FY07, will complete fabrication, assembly and demonstration of in-flight dynamic retargeting and Counter Active Protection Systems (APS) capability for Enhanced MRM; will complete fabrication, assembly and demonstration of integrated Enhanced KE in-flight performance and armor defeat capabilities; and will complete procurement, fabrication, assembly and demonstration of integrated advanced propulsion capability with temperature compensation and precision ignition.	0	13045	21855	22393
Objective Non-Line of Sight (NLOS) Mortar Technology: In FY04, built and assembled the breech loaded mortar and began single shot firing. In FY05, conduct live fire tests to demonstrate rates of fire commensurate with threshold requirements.	2300	2000	0	0
Lightweight Dismounted Mortar Weapon: In FY05, conduct lightweight material engineering evaluations, fabricate components for mechanical assessment and testballistic performance of a full-scale, lightweight barrel prototype. In FY06, will develop, test and ballistically demonstrate a full-scale system prototype of a steel tube with lightweight components.	0	3500	1960	0
Common Smart Submunition: In FY05, conduct tower tests to verify and validate performance metrics for detection, discrimination and classification of potential targets in benign and counter measured scenarios. In FY06, will conduct captive flight tests with advanced sensor and algorithm to achieve probability of discriminating of 0.90 and firing at a target of interest; will optimize and evaluate multiple effects warhead for both light and heavy targets; will conduct soft recovery vehicle tests of electronics assembly and warhead liner for survivability in high-g envrironment. In FY07, will mature sensor and algorithms for follow-on captive flight tests to achieve probability of discriminating and firing at a target of interest of 0.95; will conduct warhead performance and lethality tests; provide test data for system analysis model; and will develop a CSS system model for simulation and wargaming evaluation.	0	2207	6000	9000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Non Line of Sight Cannon (NLOS–C) Non Lethal Personnel Suppression: In FY05, conduct non-lethal payload effectiveness and dispersion analysis; refine design based on analysis; conduct initial gun launch and payload dispense test. In FY06, will demonstrate kinetic energy mitigation of payload module, and will complete target effects analysis and conduct max range system flight test demonstration.	0	4000	4000	0
Special Weapons Observation Reconnaissance Detection System (SWORDS) /Joint Manned-Unmanned System Teaming (JMUST): In FY05, will conduct testing to verify hardware and software modifications for safety certification.	0	490	0	0
Active Protection System (APS) Launchers and Countermeasures for Lightweight Platforms: In FY05, conduct warhead optimization to defeat Kinetic Energy penetrators; conduct spinning brass board sensor test; conduct dynamic warhead arena test; fabricate demonstration munition hardware. In FY06, complete integration / fabrication of demonstration munition; will conduct end-to-end dynamic flight demonstration against KE penetrator and HEAT round. In FY07, conduct warhead optimization to increase lethality and range of intercept; will conduct lightweight launcher development.	0	2021	2000	2000
Enabling Fuze Components for Advanced Munitions: In FY06, will begin explosive safety testing of Micro-Electro Mechanical Systems (MEMS) Safe and Arm (S&A) components and multipoint Electronic Safe & Arm Device (ESAD) components; evaluate performance of proximity and safety sensors in limited/simulated environmental and flight tests. In FY07, will continue explosive compatibility and safety tests of MEMs S&A's and ESADs; test proximity and safety sensors in simulated and actual flight environments.	0	0	1000	2300
Networked Sensors for the Future Force ATD: In FY04, demonstrated advanced ground target classifier and target counting algorithm in a real-time system; integrated suite of OGA developed acoustic/seismic sensors. In FY05, integrate and demonstrate the new, low cost, distributed and networked unattended ground sensor systems to evaluate capability of providing faster target identification and reaction time with reduced false alarms.	1000	1000	0	0
Common/Modular Power Sources: In FY07, will demonstrate prototype designs in laboratory and conduct air-gun tests for new thermal and liquid reserve batteries and hybrid power systems; will conduct field tests for new thermal batteries and alternative/hybrid energy systems.	0	0	0	2283
Fire Control-Node Engagement Technology: In FY04, optimized algorithms and architecture to support demonstration in a simulated environment and initiated transition of Network effects to Future Force Warrior (FFW). In FY05, will provide full functional Networked Effects Software configured for insertion into FFW ATD architecture to support a capstone demonstration.	750	750	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Rheostatic Pulsed Energy Weapons System: In FY07, will integrate DE power source technologies onto a ruggedized skid to demonstrate and assess the feasibility of further maturing and developing this technology.	0	0	0	2000
Structural Energetics: In FY05, conduct test trials in simulated tactical environment with high strength polymer-based energetic matrix formulations with graphite-reinforcement. In FY06, will conduct tests with energetic composites integrating pyrophoric reinforcements. In FY07, will conduct system demo of munition fabricated with structural energetic components.	0	500	500	800
Totals	26990	46213	47315	50776

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**L94**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
L94	ELECTRIC GUN SYS DEMO	18846	19210	18612	14721	17118	19985	24703	32203

A. Mission Description and Budget Item Justification: This project matures and demonstrates electromagnetic (EM) armament sub-systems and/or enabling technologies. EM guns have the potential to revolutionize the future battlefield by their unique performance characteristics (such as 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. The project will provide a comprehensive mission area analysis/utility assessment and will resolve system level technology challenges including synchronization/compatibility of twin rotating machines, technology scalability, thermal management, and full-energy system performance. After successful demonstration of the critical components/subsystems at tactical scale, an Advanced Technology Demonstration (ATD) will be conducted to integrate next generation sub-systems into a stand-alone medium caliber armament prototype (complete with prime power, cooling and auxiliaries) and demonstrate system performance. A collaborative program has been established with the Navy and DARPA for EM gun work by the formulation and signing of a formal Memorandum of Agreement. 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 ARDEC, Picatinny, NJ, in cooperation with the Army Research Laboratory (ARL), Adelphi, MD and The University of Texas at Austin (University Affiliated Research Center) and coordinated with their respective Program Elements: 0602618 Project AH75 and 0601104 AH56.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
EM Gun System Demo: In FY04, prepared performance specifications and point-of-departure data for the design, simulation, build and test of the Pulsed Power Supply (PPS); generated fuzed, high-explosive warhead package concepts and refined novel penetrator designs for EM gun launch testing; conducted comparative analysis of bore wear and erosion mechanisms in fired railgun surfaces versus those of propellant driven launchers; awarded pulse power subsystem contracts. In FY05, perform critical material/component evaluations including tests on composite alternator and barrel structures, low-density and high-strength metals, electrical insulation and thermal management systems, high performance solid state switches; build and test subscale launchers to begin characterizing barrel life and Integrated Launch Packages to include both kinetic energy and high-explosive projectiles; fabricate components for prototype PPS rotating machines; design PPS torque management system and mount. In FY06, will complete fabrication of a fully cantilevered railgun and demonstrate full-scale launch at hypervelocity; will perform full caliber tests with both unguided multipurpose and kinetic energy rounds and demonstrate the launchability of high-explosive and electronics ILPs in an EM armament environment; will conduct verification testing of PPS sub-assemblies and integrate the compact, twin counter-rotating pulsed alternator power supply; will conduct high fidelity breadboard PPS demonstrations to establish requisite performance criteria and subsystem functionality to transition into a proposed follow-on ATD. In FY07, will build upon the test beds to mature next generation EM armament subsystem hardware; will prepare evolutionary designs for an integrated medium caliber, line-of-sight demonstrator platform; and will assess the performance of component/subsystem designs.	18846	18252	18612	14721
Electromagnetic Gun Initiative: This one year Congressional add provides for the design, fabrication, test and evaluation of an advanced, optically controlled silicon switch for high energy pulsed duty. No additional funding is required to complete this effort.	0	958	0	0
Totals	18846	19210	18612	14721

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**L96**

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
L96	HIGH ENERGY LASER TECHNOLOGY DEMO	0	958	8000	14115	19852	25649	25001	27630

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 Laser (SSL) weapon demonstrator that complies to the form, fit, and function requirements of the Future Combat Systems (FCS). 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, rocket propelled grenades, 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 (especially improvised explosive devices (IEDs)) 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 Future Combat Systems (FCS) 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 program will use the appropriate power laser based on knowledge gained from the 100kW SSL laboratory device developed in PE 0602307A and demonstrated in FY08. Work in this project is related to, and fully coordinated with, efforts in PE 0602890 D8Z and PE 0603924D8Z (High Energy Laser Joint Technology Office), PE 0605605A (DOD High Energy Laser Systems Test Facility), PE 0603305A/TR3 (Army Missile Defense Systems Integration/Mobile Tactical High Energy Laser), 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 the US Army Space and Missile Defense Command (SMDC), in Huntsville, AL and the Army Test and Engineering Center, White Sands Missile Range, NM.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Solid State Laser (SSL) Weapons System Demonstrator: In FY06, will initiate trade studies and detailed System Engineering Designs with the Joint High Power Solid State Laser Phase II contractors for a SSL weapon system compatible with tactical ground vehicle requirements. In FY07, will assess the capabilities of the existing Air Defense target acquisition and C3I capabilities to meet the DEW specifications. Will identify and initiate required modification of these Air Defense systems and procure long lead items for 100kW laser weapon system development.	0	0	8000	14115
Future Laser Neutralization System (LNS)-- This one year Congressional Add funds the development of enhanced laser and beam control technology for future laser neutralization systems on such targets as mines, unexploded ordnance, improvised explosive devices (IED's) and their control mechanisms. No additional funds are required to complete this effort.	0	958	0	0
Totals	0	958	8000	14115

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603004A - Weapons and Munitions Advanced Technology**	**L97**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
L97	SMOKE AND OBSCURANTS ADVANCED TECHNOLOGY	0	0	1000	1020	1021	1021	1021	1021

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 IR obscurants having 4 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 protection technology 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. Funding in this project was realigned from PE06022622A project A552 to establish an advanced technology development line for technology maturation. 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 2004	FY 2005	FY 2006	FY 2007
Obscurant Enabling technologies In FY06, will mature concepts for prototype systems for use in grenades, artillery rounds, and other smoke generating systems; will identify techniques for field evaluation of prototype dissemination systems. In FY07, will refine design of prototype packaging/dissemination concepts; develop prototype system for advanced IR obscurant. Will refine modeling and verify modeling parameters. Will conduct experiments of new dissemination in a relevant environment.	0	0	1000	1020
Totals	0	0	1000	1020

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	262481	279260	142866	122661	138704	105418	100732	94306
221	COMBAT VEH SURVIVABLTY	48033	26661	18926	19951	34484	17622	27941	28153
440	ADV CBT VEHICLE TECH	1946	19954	0	0	0	0	0	0
441	COMBAT VEHICLE MOBILTY	28595	30016	52360	46025	49996	38543	49828	42774
497	COMBAT VEHICLE ELECTRO	6489	5603	9488	9324	13039	9234	9392	9539
515	ROBOTIC GROUND SYSTEMS	7126	11550	19011	20316	10026	11115	11336	11561
533	GROUND VEHICLE DEMONSTRATIONS	13961	44194	0	0	0	0	0	0
53D	NAC DEMONSTRATION INITIATIVES (CA)	45531	35758	0	0	0	0	0	0
53G	FUTURE COMBAT SYSTEMS (FCS)	109845	104766	41155	25000	29059	26753	0	0
C66	DC66	955	758	1926	2045	2100	2151	2235	2279

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, exploit opportunities to enhance Current Force vehicle-related capabilities. Army S&T continues to play an important role in the Future Combat Systems (FCS) program by providing critical technology solutions for FCS vehicles. Supporting FCS remains the highest priority for Army S&T and is the primary effort funded in this PE; therefore a significant portion of the FY04-FY07 funding supports the collaborative Army/Defense Advanced Research Projects Agency (DARPA) FCS Enabling Technologies (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), robotic ground systems (Project 515) and intra-vehicular digital electronics (Project 497). It also funds efforts to integrate and evaluate diverse vehicle technologies matured by the Army, other DoD agencies and industry. These advanced technologies are demonstrated in coordination with Army warfighter organizations through vehicle component and system level technology demonstrations. The Crew Integration and Automation Testbed (CAT) Advanced Technology Demonstrator (ATD) (Project 497) demonstrates multi-mission crew stations required for the versatility of the Future Force. The Robotic Follower ATD (Project 515) will mature and demonstrate unmanned ground vehicle technologies including those that enable UGVs to follow manned vehicles and that will allow UGVs to be more autonomous for FCS and the Future Force Warrior. The intent is to reduce the soldier's equipment burden, increase survivability and reduce the logistics burden. The Integrated Survivability ATD (Project 221) identifies the integration issues associated with upgrading FCS baseline survivability capabilities to meet FCS objective system survivability requirements, while monitoring individual technologies for direct transition opportunities into Current Force

systems. Hybrid electric and electric vehicle technologies are key enablers for enhancing Current Force, FCS and Future Force capabilities. Future vehicles will be designed with hybrid electric architectures, providing power for propulsion, communications and control systems, life support systems, and electric weapons and protection systems. In the near term, Future Tactical Truck Systems (FTTS) Advanced Concept Technology Demonstration (ACTD) (Project 440) will assess military utility of tactical vehicles that are enhanced with high payoff technologies and coupled with current and Future Force sustainment concepts in a User operational environment. The ACTD will integrate technologies including advanced propulsion (hybrid electric), mobility (electromechanical suspension and electronically controlled active braking) and intelligent load handling. In the mid-term, electromagnetic (EM) armor will be integrated and demonstrated on combat vehicles. In the longer term, vehicle energy and power levels will be increased to accommodate advanced electric weapons (e.g., lasers, high power microwave and electric guns) and advanced electric-based protection systems. Project 441 will demonstrate critical power, propulsion and electric systems, including energy storage, power distribution and Pulse Forming Networks (PFNs). Work in this program element 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 Marine Corps through the Naval Surface Warfare Center, the Naval Research Laboratory, Air Force Armaments Command, and other ground vehicle developers within the Departments of Energy, Commerce, Transportation and 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 PE is performed by the Tank Automotive Research, Development and Engineering Center (TARDEC), Warren, MI.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	203126	157373	161795
Current Budget (FY 2006/2007 PB)	279260	142866	122661
Total Adjustments	76134	-14507	-39134
Net of Program/Database Changes			
Congressional Program Reductions	-4156		
Congressional Rescissions			
Congressional Increases	87900		
Reprogrammings			
SBIR/STTR Transfer	-7610		
Adjustments to Budget Years		-14507	-39134

Change Summary Explanation:
FY07 - Funds realigned ($39134K) to higher priority requirements.

Thirty-Six FY05 Congressional Adds totaling $87900 were added to this PE.

FY05 Congressional Adds with no R-2A:
Advanced Army Modular Composite Bridge, Project 533 ($5370)
Advanced Power Trains and Intelligent Control Systems for M-Gators, Project 53D ($1438)
Advanced Thermal Management System, Project 53D ($2493)
All Composite Military Vehicle, Project 533 ($4316)
Aluminum Lightweight Structures Initiative (ALSI), Project 533 ($4891)
Armored Composite Cab Development, Project 533 ($2397)
Army Lightweight Structures Initiative (ALSI), Project 533 ($2685)
Battery Charging Technology, Project 53D ($959)
CAV Technology Transitions, Project 440

($3356)
Combat Vehicle Research, Project 533 ($4076)
Development of Logistical Fuel Processors to Meet Army, TARDEC and TACOM needs, Project 53D ($2877)
Digital Humans & Virtual Reality, Project 53D ($959)
Electrochromatic Material Windows, Project 53D ($1919)
Fastening & Joining Research, Project 533 ($1439)
FREEDOM Software Environments, Project 533 ($959)
Fuel Cell Ground Support Equipment Demonstration, Project 53D ($4411)
High Strength, Powder Metal Gears for Vehicle Transmission, Project 533 ($959)
IMPACT – Concept Modeling Tool Suite Development/Sensitivity Analysis for Military Trucks, Project 53D ($959)
Innovative Materials for Infrastructure Security, Project 533 ($2110)
International Commercially Based Logistical Support Trucks, Project 53D ($2014)
In-Theater Systems Development, Project 53D ($2350)
Military Vehicle Technologies, Project 53D ($2685)
Mobile Hydrogen Infrastructure MHI, Project 53D ($1918)
Modular Logistics Transport Technology, Project 53D ($959)
Next Generation Non-Tactical Vehicle Propulsion, Project 533 ($2493)
N-STEP Enabled Manufacturing Cell for FCS, Project 53D ($3117)
Opposed Piston, Opposed Cylinder (OPOC) Engine for Use in Auxiliary Power Unit (APU), Project 53D ($959)
Pacific Rim Corrosion Research Program, Project 533 ($1630)

Rapid Optimization of Commercial Knowledge (ROCK) Program, Project 53D ($3356)
Rapid Prototyping TACOM-UMD, Project 53D ($1438)
Rotary, Multi-Fuel, Auxiliary Power Unit (RMF-APU), Project 533 ($2014)
Secure Pervasive Computing (PvC) for Advanced Combat Vehicles, Project 533 ($3356)
Tactical Vehicle Design Tools, Project 533 ($1438)
UAV Weaponization, Project 440 ($959)
U.S. Army Hybrid Vehicle Test & Maintenance Infrastructure, Project 533 ($4076)
Virtual Systems Integration Lab, Project 53D ($959)

Projects with FY05 Congressional Adds and no R-2A are not defined due to space limitations.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**221**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
221	COMBAT VEH SURVIVABLTY	48033	26661	18926	19951	34484	17622	27941	28153

A. Mission Description and Budget Item Justification:A. Mission Description and Budget Item Justification:This project matures and demonstrates combat vehicle survivability technologies essential for FCS and the Future Force, as well as providing a potential upgrade path for survivability capabilities of the Current Force. These technologies include: Electronic Warfare (EW), Active Protection (AP), advanced lightweight armor, and signature management. As combat vehicle systems become smaller and lighter to provide the necessary strategic deployability and tactical mobility, one of the greatest technological and operational challenges is providing adequate crew and vehicle protection without reliance on heavy passive armor. This challenge will be met by using a layered approach, including long-range situational awareness, multi-spectral signature reduction, EW and AP system, and advanced lightweight armor instead of heavy conventional armor. These technologies will be demonstrated over time as distinct focused efforts under an Integrated Survivability Advanced Technology Demonstration (IS ATD). The goal of the IS ATD is to provide "convincing evidence" of soldier/system survivability through actual hardware field demonstrations, and modeling and simulation (M&S) of AP systems in connection with light weight armor. Initial IS ATD efforts demonstrate technologies for a system that is effective against Chemical Energy (CE) anti-tank guided missiles (ATGMs), rocket propelled grenades (RPGs) and tank fired high explosive anti-tank (HEAT) munitions. The goal of the AP against CE effort is to demonstrate hard kill (physical interruption with a countermeasure warhead) and soft kill (EW spoofers and jammers) while the vehicle is On-The-Move (OTM). Once the CE APS has been demonstrated, the focus will shift to the defeat of Kinetic Energy (KE) threats. The goal of the AP against KE effort is to defeat KE threats with a multi-purpose hard kill countermeasure warhead. The goal of the Ballistic Protection effort is to provide a suite of lightweight armor component technologies for all manned FCS ground vehicle variants. Armor technologies include electromagnetic (EM), smart and ceramic armors integrated with advanced composite and laminate structures. Lightweight, integrated armor technologies, using components from PEs 0602601A (Combat Vehicle and Automotive Technology), 0602618A (Ballistics Technology) and 0602105A (Materials Technology), will be demonstrated through ballistic testing of quarter vehicle sections to validate performance versus weight as required for frontal and side armor protection. The goal of the FCS Laser Hardened Vision & Sensor/Eye Protection efforts is to develop optical systems for battlefield viewing and fire control, which are protected from frequency agile laser weapons. Nonlinear optical materials will be incorporated into new optical designs to meet the needs of FCS. The goal of the Full Spectrum Active Protection Close in Layered Shield (FCLAS) effort develop the capability to defeat Rocket Propelled Grenades (RPGs) and small Anti-Tank Guided Missiles (ATGMs) on a light, moving platform with a vehicle integrated countermunition costing less than $3,000. The Signature Management effort will improve existing multi-spectral signature modeling tools, characterize hardware performance, and provide inputs to FCS virtual prototyping tools. The technical goal is to achieve an 80% signature reduction in a validated virtual combat vehicle concept. Multi-spectral combat vehicle signature models will be validated using hardware samples with measured signature characteristics and will be used to assess FCS platform designs. Work in this PE is related to and closely coordinated with work conducted in PE 0602601 (Combat Vehicle and Automotive Technology) and in collaboration with the Army Research Laboratory's PE 0602618 (Ballistics 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 Technology Area Plan (DTAP). 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 Army Research, Development and Engineering Center (ARDEC), Picatinny, NJ.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
AP and EW against CE: In FY04, conducted OTM tests to demonstrate the CE AP system against advanced tank fired HEAT threats, ATGMs, and RPGs using explosive countermeasure; designed and integrated two EW countermeasures into a single multi-function jammer head; designed explosive countermeasure; developed tracking radar and countermeasure launcher components for improved performance; conducted OTM tests with the system mounted on a testbed vehicle in an outdoor range environment; matured stabilization algorithms for objective vehicle speeds. In FY05, test mature OTM algorithms for EW; field test multi-function EW countermeasure; complete OTM field test of the full hemispherical, vehicle-mounted AP/EW system; and provide design information on the demonstrated components and system to appropriate acquisition program(s).	10462	7143	0	0
AP against KE - In FY04, conducted technology trade studies, early component experimentation, M&S, and system concept evaluations; evaluated KE countermeasure warhead concepts including a pure blast warhead; assessed blast concept countermeasure warhead against KE, CE and ATGM flying threats; began radar upgrade toward enabling tracking of CE and KE threats; purchased threat munitions to support experimentation. In FY05, select KE AP countermeasure components to be demonstrated for the IS ATD and FCS; complete KE/CE AP system design, conduct laboratory tests of the countermeasure interceptor; complete upgrade to AP tracking radar to incorporate KE capability. In FY06, will test Mark II interceptors from stationary position to demonstrate accuracy of KE capable AP system; will assess tracking radar, interceptor, and launcher assembly against KE threats, characterize kill radius and warhead blast effect; will integrate tracking radar, interceptor and launcher onto IS ATD test bed; will demonstrate accuracy of KE-capable AP System in static fly-out field test and will initiate KE alternative warhead development. In FY07, will evaluate test results and re-evaluate AP system with candidate warhead designs; will select interceptor and warhead design by FCS Preliminary Design Review (PDR); will mature selected interceptor and warhead through design refinement, sensor redesign, kill mechanism, and sensor component tests; will begin detailed design of mature KE interceptor for fabrication.	14788	6132	12676	16658

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
AP against close-in threats (Full Spectrum Active Protection Close In Layered Shield (FCLAS)): In FY04, installed prototype system on a test platform, including integrated FCLAS munitions, launcher and smoke controller; conducted static tests to demonstrate the ability to defeat. In FY05, demonstrate an automated system by which FCLAS will minimize collateral damage and avoid opportunities for injury to personnel in the vicinity of the vehicle and demonstrate system modularity; modify existing sensor to increase effectiveness against RPG's; and demonstrate FCLAS system on a moving platform. In FY06, will test upgraded versions of FCLAS configurations for other possible applications including man portable surface to air missiles and smart mines.	9000	5512	3850	0
Signature Management - In FY04, developed enhanced modeling capability including exhaust plume signature effects and integration with synthetic imagery; optimized field performance of hardware in preparation for FY05 model validation tests. In FY05, develop and validate full capability signature management virtual models; provide robust signature modeling capability to Research Development and Engineering Command's Modeling Architecture for Technical and Research Experimentation (MATREX).	5000	4937	0	0
Ballistic Protection for FCS - In FY04, completed electromagnetic (EM) armor component maturation; built vehicle quarter sections comprising of a combination of EM, ceramic and structural armor materials; conducted tests of armor sections against FCS objective threats; demonstrated capability to provide adequate protection at acceptable weights and determined soundness of armor/structural design. In FY05, conduct ballistic range tests to optimize and validate the performance of integrated armor packages for lightweight test platforms; complete integration of armor appliqué solutions for FCS objective threats; test advanced medium KE frontal armor and improved RPG defeat (with Signature Management treatments applied to determine their robustness) for the FCS-armor testbed.	7783	2441	0	0
Countermine (Lightweight Appliqués and Structures): In FY04, evaluated mine protection armor configurations; obtained improved mine blast test data, and validated M&S. In FY05, complete evaluation of FCS mine resistant lower hull appliqué concept(s) integrated into FCS prototype designs; use finite element models to evaluate FCS prototype vehicle designs against multiple mine scenarios to assess capabilities beyond single blast events.	1000	496	0	0
Synergistic Survivability: In FY07, evaluate survivability suite(s) and component technologies for regional protection to protect multiple vehicles and/or designated areas (such as formations, staging areas, or convoys) from various CE and/or KE threats.	0	0	0	564

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
FCS Laser Hardened Vision/ Sensor/Eye Protection from Frequency-Agile Lasers: In FY06, will initiate brassboard build of FCS targeting camera system for manned ground vehicle and design of FCS targeting optical system (using the eye as the sensor) protected from damage induced by wavelength-agile laser weapons. In FY07, will integrate and evaluate nonlinear optical materials solutions that protect the sensor from laser-induced damage and initiate a brassboard build of targeting system utilizing these concepts; design laser protected FCS navigation camera system.	0	0	2400	2729
Totals	48033	26661	18926	19951

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**441**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
441	COMBAT VEHICLE MOBILTY	28595	30016	52360	46025	49996	38543	49828	42774

A. Mission Description and Budget Item Justification: A. Mission Description and Budget Item Justification: This project develops and tests advanced mobility and electric component technologies for next generation combat vehicles and demonstrates increased vehicle performance and capability. It enables lightweight, agile, deployable, fuel efficient and survivable ground combat vehicles needed for FCS, the Future Force, and enhancements to the Current Force. The main efforts funded by this project are Hybrid Electric Vehicle (HEV) FCS Propulsion Technologies, FCS Engine, Advanced HEV Technologies, Fuel Cells, and Pulse Power. HEV FCS Propulsion matures components, sub-systems and systems for hybrid-electric vehicles including power distribution and storage systems, traction motors, active suspension, high-density capacitors and pulse power components, and high-temperature silicon/silicon carbide electronics. Demonstrations of these items will be conducted in the Power and Energy (P&E) Hardware-in-the-Loop Systems Integration Laboratory (SIL) that replicates combat vehicle power and vehicle performance characteristics. (The P&E SIL is the name for the Combat Hybrid Powers Systems SIL, previously funded in this project.) HEV technology offers improved automotive performance, significant reduction in fuel consumption (in the range of 20% savings over today's combat vehicles), silent watch and silent mobility, and vehicle design flexibility. The P&E SIL will demonstrate electrical power and energy sources, significantly enhanced control methodologies, and electrical architectures (enabled by high-speed switching) to provide on-board power management. The P&E SIL is also used as a cost effective way to validate vehicle performance models and simulations. Beginning in FY06, promising technologies will transition to the Hybrid Electric Mobile Dynamic Test Rig for component testing. These efforts support the DoD Power and Energy Initiative. The goal of the FCS Engine effort is to mature and demonstrate prime power (engines) options for hybrid combat vehicles with a goal to double the power density (horsepower per cubic foot (hp/cu.ft.)) of a comparable, state-of-the-art, militarized commercial engine. The goal of the effort is to demonstrate a prototype engine system with power density of no less than 6 hp/cu.ft. Beginning in FY05, Fuel Cell Power effort will be pursued to accelerate the maturation and application to military vehicle power generation as an alternative to the reciprocating engine for Auxiliary Power Units (APUs) and prime power. The Advanced HEV Technologies efforts will seek further increases in vehicle mobility, efficiency and mission capability without increasing vehicle weight and volume. This effort will apply advanced technologies (traction wheel motors, active suspension, high temperature electronic components, regenerative brakes, thermal management, lightweight track and band track) to next generation vehicles and identify changes in vehicle performance. The objective of the Pulse Power effort is to mature pulse power component technology options and demonstrate compact pulse power components that enable revolutionary survivability and lethality applications. The goal is to accelerate maturation of high power density, capacitor-based Pulse-Forming Networks (PFNs) for Electromagnetic (EM) armor and advanced weapons for FCS spiral insertions. 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), Adelphi, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
HEV FCS Propulsion – In FY04, implemented strategy for upgrading hybrid electric propulsion, band track, and suspension technologies for potential FCS insertion; demonstrated power densities of compact FCS components to objective (goal) power levels (200 kiloWatt (kW) per cubic meter (cu.m.)). In FY05, evaluate advanced hybrid electric components in the P&E SIL; demonstrate significantly increased hybrid electric system power density in the P&E SIL; advance M&S capability to include real time power and energy vehicle analyses; begin design of an integrated mobile Dynamic Test Rig (DTR). Perform trade-off and performance assessments of spiral upgrade concepts for FCS and the current force; develop detailed power and energy mission profile data; and provide vehicle integration support. In FY06, will integrate and evaluate enhanced hybrid electric components in the P&E SIL and in the DTR, with upgrades to band track and advanced suspension systems; demonstrate significantly increased hybrid electric system power density (from current 4 cu.m. volume range to 3 cu.m.). In FY07, will continue to integrate new component technologies to support the creation of a 2 cu.m. sized hybrid electric system power.	5718	9364	20471	12271
FCS Engine - In FY04, completed performance improvement, mechanical durability testing and 50 hour NATO durability laboratory demonstration for three FCS engine candidates (two diesel and one turbine). In FY05, optimize engine for hybrid electric FCS-specific vehicle application; reconfigure an in-line 4 cylinder FCS candidate engine for spiral technology application to current platforms.	9800	9880	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Hybrid Electric Vehicle (HEV) Technologies - In FY04, demonstrated improved electric traction motor with reduced weight and volume characteristics; matured 10 kW high-temperature all-Silicon Carbide (SiC) motor inverter for improved power density; tested improved 600 Volt Lithium-Ion (Li-Ion) battery for improved efficiency and reduced volume; matured and demonstrated Si/SiC 50 kW DC-DC converter for higher frequency and reduced volume; matured SiC 10 kW DC-DC converter and scale to 50 kW; and adapted lab capabilities to emulate full electric hybrid system for FCS spiral insertions. In FY05, demonstrate 30 kW high-temperature all-SiC motor inverter; advance Li-Ion battery technology to achieve higher energy/power densities; demonstrate improved traction motor and active electric suspension for FCS spirals; continue to advance the performance and maturity of component technologies to allow integration and characterization at the subsystem and system level; perform optimization and validation in collaboration with the HEV FCS Propulsion efforts; provide upgrades to power and energy modeling and simulation efforts. In FY06, will demonstrate 40 kW high temperature all-SiC motor inverter; will demonstrate enhancements to Li-Ion battery technology (up to 120 Wh/kg); will demonstrate 100 kW/cu.ft. traction motor; advance component and system performance and maturity, providing upgrades to power and energy M&S efforts. In FY07, will mature inverter, battery, traction motor and DC-DC converter component technologies; will provide demonstrations and test system integration in the P&E SIL; will validate advanced thermal management technologies for coolant temperatures in the range of 110 degrees C during system demonstrations.	8173	5418	11499	10148
Pulse Power: In FY04, matured and demonstrated high energy density capacitors, high power density/high temp Si/SiC pulse chargers; and high action/fast rise-time output switches. In FY05, incorporate components into high-energy density, dual mode PFN for EM Armor/Electrothermal Chemical Gun and evaluate the PFN in the P&E SIL; fabricate and demonstrate modular, high-action solid state output switches in support of EM Gun development; and design and develop higher energy density PFN circuit boards in support of the Solid State Laser (SSL); provide Operational Effectiveness Modeling and Life Cycle Cost Estimate support for Power Duty Cycle Analysis. In FY06, will continue to improve component (capacitors, pulse chargers and switches) characteristics and performance ranges, spiraling these into the high-energy density, dual mode PFN; integrate and test SSL PFN/Power Supply/Diode Load into P&E SIL. In FY07, will achieve technical maturity and size reduction goals for all components for the high-energy density, dual mode PFN, the SSL PFN and EM Gun switch, validating performance in the P&E SIL.	4904	4234	15972	15926

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Fuel Cell Power: In FY05, complete power studies and select two conventional and two fuel cell approaches for advanced development; initiate design for laboratory hardware integration, performance demonstration, and durability maturation to achieve future combat vehicle propulsion system power density requirements. In FY06, will mature selected conventional and fuel cell technology approaches refining fuel cell system models and simulations in preparation for FY07 decisions. In FY07, will down-select an APU system development approach, mature selected technologies and begin system integration efforts to culminate in laboratory hardware APU performance demonstration.	0	1120	4418	7680
Totals	28595	30016	52360	46025

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**497**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
497	COMBAT VEHICLE ELECTRO	6489	5603	9488	9324	13039	9234	9392	9539

A. Mission Description and Budget Item Justification: This project matures and demonstrates vehicle electronics hardware and software that will result in increased crew efficiencies/performance and/or reduced crew size for FCS vehicles and potential upgrades of Current Force systems. In addition, the project advances open system architectures for ground combat vehicles that will allow vehicle crew stations to be adapted for a variety of FCS and Future Force ground platforms. The primary effort is the Crew Integration and Automation Testbed (CAT) Advanced Technology Demonstration (ATD), which focuses on automation of crew functions and integration of advanced electronic architecture compatible with automotive and system platform requirements. Products include simplified/user friendly, responsive controls for unmanned ground and air systems, and up to 30% reduction in software and modified commercial power architecture. CAT ATD, in cooperation with Robotic Follower ATD (Project 515), will evaluate configurations of multi-role crew stations that may enable a two-man crew to perform functions associated with fighting the battle, reconnaissance, logistics and sustainment, as well as control of unmanned ground and air vehicle assets. Goals include a 30% reduction in software cost, a ten-fold increase in architecture throughput, and full mission rehearsal via embedded simulation that will be relevant to FCS. Technical challenges include achieving increased levels of autonomy for both manned and unmanned systems, an advanced user interface supporting improved/increased span of control for mixed initiative (e.g. reconnaissance and lethality) robotic operations, mixed mode operations with both unmanned ground and aerial assets, collaborative vehicle operations for workload management, continued maturity of auto driving aids, commanders aids, embedded simulation for battlefield visualization, and fully integrated virtual test and evaluation. The Human-Robot Interaction (HRI) effort will mature and demonstrate a common scaleable user interface that maximizes Soldier performance of primary mission tasks. A common interface will reduce platform unique training requirements through the use of intuitive interfaces and adaptive automation for the control of unmanned ground and air systems. It will mature advanced models, metrics, and design guidelines for optimal mounted and dismounted soldier-robotic performance, and employ this information to mature, integrate and demonstrate technology required for effective interaction with both air and ground unmanned battlefield systems. This effort will implement model-driven embedded intelligent agents that optimize soldier workload, reduce and or automate controlling tasks, support adaptive and dynamic performance across mounted (embedded) and dismounted systems and enable efficient mixed-initiative operations where manned and unmanned systems team to perform missions. A common interface will increase situational awareness and understanding and provide FCS mounted and dismounted troops control of all unmanned assets. The Advanced Mobile integrated Power System (AMPS) effort previously in this project has been incorporated in the effort funded by Project 441; the remaining funds provide the support for the collaboration. 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 2004	FY 2005	FY 2006	FY 2007
CAT ATD: In FY04, defined cognitive decision aids; continued integration and field testing of advanced crew station configurations; refined the electronics architecture and Embedded Simulation System (ESS); investigated the use of system automation features to the commander's aid, such as the ability to infer operator's intent; integrated UAV control and route planning aids into the Soldier-Machine Interface (SMI); investigated the use of pedestrian/dismounted soldier identification for improved safety and workload reduction; performed technology assessment to support a distributed digital indirect vision system for closed hatch combat vehicle driving operations; integrated an intelligent tutoring system for combat operations and training into the ESS for field experimentation; extended the ESS to support mission rehearsal capabilities for dismounted soldiers. In FY05, participate in Future Force Warrior (FFW) experiments; continue to investigate technology enablers for on-the-move embedded simulation and mission rehearsal; implement and test ground vehicle autopilot capability using an upgraded autonomous mobility sensor suite; mature a distributed workload management system across manned/unmanned assets that support the FCS network centric concept by integrating FC-Net weapon/target pairing. In FY06, will continue to participate in FFW experiments; will support the Joint-Manned/Unmanned Systems Teaming program; test the objective SMI; test commander's and driver's aids to include auto-pilot and unmanned asset planning features; test high frequency electronic control architecture; test embedded mission planning, mission rehearsal, and training capabilities; create final technical reports and provide to PM Unit of Action.	5489	3995	1945	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Technology for Human-Robot Interactions (HRI) in Soldier-Robot Teaming: In FY05, establish baseline intelligent agent functionality and cognitive modeling for reduction and automation of soldier workload to control ground and air unmanned assets; establish platform baselines of scalable interface for the reduction of mounted and dismounted soldier training burden. In FY06, begin software development of intelligent agents; initiate design for common scalable interface; transition initial common scalable interface for control of air and ground unmanned systems to FCS and FFW; continue cognitive model development; demonstrate a reduction of non-critical alert frequency; show a reduction of mission planning/re-planning timelines; demonstrate a reduction of soldier control workload portion of overall mission; reduce unique training requirements between mounted/dismounted operations; refine and validate requirements for adaptive automation; refine and validate requirements for FCS compatible interfaces. In FY07, continue refinement and test of intelligent agent software; determine optimal workload levels for selected operational contexts; enhance cognitive models; decrease non-critical alert frequencies; reduce mission planning/re-planning timelines; reduce soldier control workload though advances in task automation; develop adaptive automation algorithms.	0	1341	7243	9324
Advanced Mobile Integrated Power System (AMPS): In FY04, Investigated and developed advanced smart 42V power alternator, smart energy storage devices, and smart power architecture; demonstrated power architecture concept using modeling & simulation.	500	0	0	0
Enhanced Combined Arms Team Training: - In FY04, developed vehicle requirements, architecture specification, and vehicle Soldier-Machine Interface to support in-vehicle intelligent tutoring; integrated these efforts into the Crew Integration and Automation Test bed for testing.	500	0	0	0
Hybrid Electric Component Development: In FY05, will adapt flex-bus power distribution and smart power and control modules. In FY06, will integrate intelligent power management architecture with power distribution and control modules.	0	267	300	0
Totals	6489	5603	9488	9324

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**515**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
515	ROBOTIC GROUND SYSTEMS	7126	11550	19011	20316	10026	11115	11336	11561

A. Mission Description and Budget Item Justification:: This project matures and demonstrates unmanned ground vehicle technologies for the FCS, the Future Force, and to explore the feasibility to enhance the current force. The main focus is on integrating and demonstrating sensor technologies/perception hardware and software, and robotic control technologies that are required to enable unmanned ground vehicle (UGV) systems to maneuver with minimal human intervention, for on-and off-road missions while at militarily significant speeds. Mature technologies are incorporated in UGV technology demonstrators, whose performance can be evaluated for multiple tactical and sustainment applications. Technical challenges addressed include: obstacle avoidance, perception limitations, intelligent situational behaviors, command and control, frequency of human intervention, and adverse weather operation. The Robotic Follower, Advanced Technology Demonstrator (ATD) focuses on UGVs that follow other vehicles directly or follow a designated path, requiring little human intervention. An experimental UGV (XUV) and a converted Stryker Infantry Carrier variant (robotic Stryker) serve as test vehicles. The minimum exit criteria for the ATD are: 5 km separations between leader and follower, 160 km mobility range, obstacle detection for objects 0.3 sq.m. in size, and minimum operator intervention of no more than 1 per 5km @20km/hr). This ATD is a cooperative effort between the Tank Automotive, Research, Development and Engineering Center (TARDEC) and the Army Research Laboratory (ARL), using component technologies matured in PE 0602618A (Ballistics Technology). In the near term, this ATD provides critical information on design and performance of robotic technologies and demonstrations of Follower UGVs for FCS. Potential applications include re-supply vehicles and Soldier MULEs that may be used to reduce each Soldier's carried load by 40-50 pounds. In the farther term, the project will advance UGV technologies to enable semi-autonomous and autonomous operation and to expand the missions to which UGVs contribute in FCS. The Armed Robotic Vehicle (ARV) Robotic Technologies (ART) effort matures a set of automated tactical behaviors that are consistent with the unmanned platform missions in the FCS Unit of Action. These behavior algorithms will be integrated with sensor hardware, components that enable advanced mobility and UGV survivability, and appropriate mission modules, and integrated onto surrogate ARV demonstrators to support FCS enhancement via spiral insertion. Potential missions/functions include perimeter security, medical supply and evacuation, scout/reconnaissance and remote weapons delivery. The Technology for Human-Robot Interaction in Soldier-Robot Teaming effort develops a common scaleable warfighter interface that maximizes soldier performance by minimizing required interactions and workload in the control of unmanned ground/air systems. It develops advanced models and design guidelines and implements model-driven intelligent agents that optimize workload, reduce or automate controlling tasks, support adaptive and dynamic performance, and enable efficient mixed-initiative operations where manned and unmanned systems team to perform missions, to reduce soldier burden and accelerate fielding of soldier-robot teams for FCS and Future Force Warrior (FFW). The approach builds upon previous and ongoing investments such as the Demo III program, conducted under the Joint Robotics Program Office, and the DARPA UGCV program. It is coordinated with the Crew Integration & Automation Testbed (CAT) ATD (described in Project 497). 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 TARDEC, Warren, MI, in conjunction with the ARL, Adelphi, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Robotic Follower: In FY04, matured sensor data/map registration and trail detection technologies to obtain following speeds of 40km/hr cross-county; integrated enhanced autonomous mobility algorithms and next generation perception sensor from ARL Semi-autonomous Robotics for FCS effort; matured robotic virtual construction and test environment to enable hardware in the loop modeling and simulation; conducted engineering evaluations and soldier operational testing of follower capability in logistic and tactical mission scenarios. In FY05, mature/incorporate intelligent situational behavior to significantly increase separation times and distances and assist in prevention of communication loss or mobility kill; mature/integrate vehicle tracking capability to enable operation within traffic; mature pedestrian detection capability to enable safe operation amongst pedestrian traffic; conduct engineering evaluations and Soldier operational testing of follower capability in logistic and tactical mission scenarios; participate in command and control robotic experiments; conduct urban operations experiment in conjunction with the FFW program. In FY06, will integrate improved obstacle detection algorithms for detection of small positive and negative obstacles; will implement road following traffic avoidance baseline for improved lane maintenance as well as traffic/pedestrian detection and avoidance; will implement improved leader-follower technology with increased mobility and waypoints augmented with terrain intelligent navigation; will demonstrate significant operator workload reduction; will conduct FFW test activities focused on dismounted support and MULE operations in urban areas; perform final engineering evaluations and operational warfighter experiments that test to full ATD exit criteria; create final technical reports/documentation and transfer to FCS and FFW programs.	7126	6973	3000	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Armed Robotic Vehicle (ARV) Robotic Technologies (ART): In FY05, create a tactical behavior suite that allows the unmanned system to act decisively while maneuvering around the battlefield (i.e. reacting to indirect fire with appropriate tactical maneuver); ensure that the unmanned systems have comparable maneuverability to the manned (mounted and dismounted) systems that will be operating with them; demonstrate tactical behavior suite and maneuverability in a simulated setting prior to the technology being integrated into the surrogate ARV demonstrators. In FY06, will refine semi-autonomous perception to improve operations in fog/dust and reduce frequency of operator interventions; will advance unmanned tactical behaviors in conjunction with the user requirements; will advance UGV mobility to meet the FCS threshold mobility requirements; will increase UGV survivability through addition of anti-tampering, signature reduction, and self-monitoring capabilities; will continue to mature UGV mobility SIL for tactical behavior and maneuverability development; begin to integrate pacing technologies into ARV surrogate platforms; will demonstrate advanced capabilities with interoperability with the Ground Soldier System; will conduct FCS risk reduction demonstrations; will conduct warfighter evaluations and experiments independently and jointly with the Technology for Human-Robot Interaction (HRI), and Command and Control of Robotic Entities programs. In FY07, will continue to mature tactical behavior developments, semi-autonomous perception, intrinsic mobility and survivability technologies, which have deliverables to FCS; will integrate ART subsystems into test platform or demonstrator in preparation for final exit criteria field testing and warfighter experiment in FY08.	0	4577	14056	16319
Technology for HRI in Soldier – Robot Teaming: In FY06, will perform iterative data collection and modeling of Soldier and robot interactions; will develop and transition to FCS and FFW initial Soldier-robot interaction models; will support FCS and FFW unmanned systems experiments. In FY07, will draft guidance for design of Soldier-robot teams interaction and performance; will model Soldier-robot team performance and transition improved and validated Soldier-robot interaction models to FCS and FFW; will integrate hardware/software with existing manned and unmanned platforms in preparation for FY08 exit criteria field testing.	0	0	1955	3997
Totals	7126	11550	19011	20316

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603005A - Combat Vehicle and Automotive Advanced Technology**	**53G**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
53G	FUTURE COMBAT SYSTEMS (FCS)	109845	104766	41155	25000	29059	26753	0	0

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 the number one priority for Army S&T. This project funds the Army's share of the Army/ DARPA Enabling Technologies for FCS collaboration. Funds in this project are provided to 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. NetFires, which demonstrated mobile BLOS capability for precision, loitering munitions and transitioned to the Army in FY04. FCS Communications, which demonstrates high data rate, low probability of detection and anti-jam communications to achieve secure, reliable networked communications transitioned to the Army in FY04. Major efforts include the following: Unmanned Ground Combat Vehicle (UGCV)/PerceptOR Integration (UPI), which matures and demonstrates an Armed Robotic Vehicle (ARV) class vehicle with advanced sensors to enable agile, tactical performance and reduce ARV development risk. Affordable Adaptive Conformal Electronically Steerable 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. FCS 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. Micro Air Vehicle (MAV) ACTD, which demonstrates the utility of an affordable, man-portable, and responsive reconnaissance and surveillance UAV that fits into a backpack. 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. Mobile Network Multiple Input Multiple Output (MIMO) (MNM), which demonstrates a mobile MIMO radio network in a legacy radio form factor. Sensor DART, which demonstrates earth-penetrating unmanned ground sensors (UGS)-darts that are dispensed from a glider that can be released from an airborne platform or launched from a ground platform. Electromagnetic (EM) Mortar, which demonstrates an EM launch capability for large caliber mortar-type weapons. DP-5X, which demonstrates an alternative Class-III UAV utilizing a multifunctional vertical take off and landing (VTOL) UAV design. Enabled Battle Command for the Unit of Employment (EBC), which demonstrates software decision support tools that can be refined or developed on-the-fly as the campaign unfolds. Air Assault Expeditionary Force Experiment (AAEFE), 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 2004	FY 2005	FY 2006	FY 2007
In FY04: NetFires - completed controlled test vehicle demonstrations and transitioned to PM Tactical Missiles; UPI identified candidate perception sensors and algorithms; FCS Command and Control (C2) - ported software to the FCS UA; FCS Communications - transitioned to FCS Lead Systems Integrator; MAV - conducted critical design review (CDR) and implemented demonstrator build; Jigsaw - conducted a preliminary design review (PDR) and executed system trades; FORESTER - conducted sensor testing to detect dismounts in foliage; AACER - awarded contracts for demonstrators; Sensor Dart initiated preliminary concept studies; WolfPack - performed initial component demonstrations; OAV - initiated concept definition source selection; MNM - demonstrated preliminary mobile network concept; AAEFE - assessed warfighting utility of FCS enabling technologies and concepts; EBC initiated concept development and demonstration of proof of concept; DP-5X - demonstrated flight components in laboratory and test rig; EM Mortar - initiated design and component evaluation of two competing EM technology approaches (rail and coil).	109845	0	0	0
In FY05: UPI - evaluate and test algorithms with a UGCV mounted weapon system; Jigsaw - conduct critical design review (CDR) and initiate demonstrator fabrication; FCS C2 - develop and demonstrate operational and systems C4ISR architectural framework products; FORESTER - design, assess and evaluate a brassboard hardware system; AACER - evaluate preliminary system designs, production cost estimates, and results from critical antenna technology demonstrations and down select to best design(s); Sensor Dart - perform PDR and implement fabrication of demonstrator hardware; MAV - perform demonstrator flight testing and downselect a diesel engine design; WolfPack - refine and improve demonstrator design based on initial demonstrations; OAV - perform PDR for concept downselect and implement demonstrator design; MNM - implement competitive demonstrator hardware fabrication to validate concept with field demonstration of the Mobile Ad Hoc Network and custom wideband RF/signal processing designs; AAEFE - perform detailed analysis and execute pilot demonstration testing; EBC - develop preliminary demonstration software tool set; DP-5X - perform flight test demonstrations with 75lb. payload and waypoint navigation; EM Mortar - perform laboratory demonstrations of EM coil and rail technology.	0	104766	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
In FY06, UPI - will make the selection of weapon payload and integrator, and conduct initial demonstration testing of two platforms; FCS C2 - will conduct human-in-the-loop experiments; MAV - will conduct flight-testing and experimentation with 25th ID; FORESTER - will design, assess, and evaluate 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; AACER - will complete fabrication of demonstrator modules and perform subsystem tests, system integration, and rooftop tests; Jigsaw - will complete fabrication of demonstrator equipment and demonstrate active 3-D imaging for hard-to-identify targets; Sensor Dart - will complete demonstrator fabrication and perform flight demonstrations; MAV - will complete diesel powered demonstrator and perform User trials with demonstrator equipment; WolfPack - will demonstrate threat sensor/jammer capabilities as part of the FCS C4ISR structure; OAV - will complete CDR and initiate demonstrator fabrication; MNM - will perform 2-node demonstration tests; AAEFE - will execute a full scale experimental demonstration; EBC - will expand functionality of the demonstration software tool set; DP-5X - will perform flight demonstration tests with weapons payload and demonstrate potential operational scenarios.	0	0	41155	0
In FY07, UPI - will conduct full-up demonstration of enhanced capability sensors on two platforms; AACER - will fabricate optimized integrated airborne system and perform ground performance demonstrations; OAV - will perform demonstrator ground and flight tests; MNM - will perform 10-node demonstration tests on improved MIMO hardware/software demonstrator; AAEFE - will perform operational assessment of warfighting utility of FCS enabling technologies and concepts, in an operational environment, via experimentation with surrogates and mature demonstrator hardware/software; EBC - will transition a robust software tool set capable of providing desired cause/effect prediction and analysis capability to FCS.	0	0	0	25000
Totals	109845	104766	41155	25000

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603006A - Command, Control, Communications Advanced Technolo**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		9303	9544	12066	11040	11103	6364	6422	6471
257	DIGITAL BATTLEFLD COMM	1071	0	0	0	0	0	0	0
588	HIGH ALTITUDE AIRSHIP ACTD	2841	2775	3000	0	0	0	0	0
592	SPACE APPLICATION TECH	5391	6769	9066	11040	11103	6364	6422	6471

A. Mission Description and Budget Item Justification: The name of this program element (PE) was changed in FY03 to Space Applications Technology. This program matures and demonstrates advanced space technology applications for 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 Control ground-to-space surveillance, negation and battle management 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 program 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 program provides Space Control advanced technology risk reduction capability for ground-to-space surveillance and space object negation (disrupt, degrade, deny, and destroy) system development. Additionally, it matures near space application of airship structure, propulsion, flight control, and power generation technologies to carry heavy multi-mission payloads for airship long dwell time at 65,000 feet in High Altitude Airship ACTD. 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. Funding for non-space related efforts, including Command, Control, and Communications (C3), was realigned to PE 0603008A in FY03.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	9946	14352	14910
Current Budget (FY 2006/2007 PB)	9544	12066	11040
Total Adjustments	-402	-2286	-3870
Net of Program/Database Changes			
Congressional Program Reductions	-145		
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer	-257		
Adjustments to Budget Years		-2286	-3870

Change Summary Explanation:
FY06 - Funds realigned ($2286K) to higher priority requirements.
FY07 - Funds realigned ($3870K) to higher priority requirements.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603006A - Command, Control, Communications Advanced Technolo**	**588**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
588	HIGH ALTITUDE AIRSHIP ACTD	2841	2775	3000	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project validates and demonstrates the technology, engineering feasibility and potential military utility of a large unmanned, helium filled airship within an Advanced Concept Technology Demonstration (ACTD). This High Altitude Airship (HAA) ACTD will demonstrate capabilities to fly un-tethered at 65,000 feet, carry a heavy multi-mission payload, self deploy from continental United States (CONUS) to worldwide locations, and remain on-station for weeks to months before returning to a fixed launch and recovery area in CONUS for service on the ground. HAA technologies will focus on airframe structures and related components to carry payloads which augment space-based capabilities and missile defense architectures. The airship payload will consist of a communication relay and sensor suite to support the Future Force. Other agencies providing additional support and funding include Missile Defense Agency, and Office of the Secretary 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 is performed by the US Army Space and Missile Defense Technical Center in Huntsville, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- FY04 - completed airship design and review. Program decision was made to focus on technology maturation. In FY05, these funds constitute the Army's contribution to the HAA ACTD to initiate the airship prototype development, build and demonstration focusing on component technology maturation. In FY06, these funds constitute the Army's contribution to the HAA ACTD to initiate the airship prototype development, build and demonstration focusing on subsystem integration and ground level testing.	2841	2775	3000	0
Totals	2841	2775	3000	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603006A - Command, Control, Communications Advanced Technolo**	**592**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
592	SPACE APPLICATION TECH	5391	6769	9066	11040	11103	6364	6422	6471

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 Control ground-to-space surveillance, negation and battle management 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 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 provides Space Control advanced technology risk reduction capability for ground-to-space surveillance and space object negation (disrupt, degrade, deny and destroy) 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 2004	FY 2005	FY 2006	FY 2007
Distributed Imaging Radar Technology - In FY04, performed initial testing and algorithm assessment of the Distributed Imaging Radar Technology concept using existing radar data. In FY05, verify the algorithms; detect and locate moving targets using distributed radar and space-time coded aperture waveforms; and initiate miniaturization of high fidelity and stabilized radar receiver/exciter hardware for Upper Tier and space platform application. In FY06, verify algorithms for distributed array implementation of Moving Target Indication (MTI) and develop radar component required for integrated distributed aperture demo with precise time synchronization. In FY07, field demonstrate the distributed aperture radar brassboard with wide area MTI and imaging of moving targets software.	2891	4120	6497	6343

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
All Weather Radio Frequency (RF) Launch Detection - In FY05, assess All Weather Radio Frequency (RF) Launch Detection signatures for rockets, artillery, and mortars. Initiate characterization algorithm development and broadband high/low RF receiver design for real time processor applications. In FY06, initiate development of detection, location and classification algorithms and demonstrate feasibility. In FY07, will initiate RF receiver fabrication to implement the baseline algorithm; mature algorithms and expand threat set; expand frequency band of receivers and extend field of view for increased detection range.	0	2649	2569	4697
Space Surveillance - In FY04, completed hardware/software integration, test, and demonstrated near real time threat assessment in a simulated operational environment; transitioned technology to Army Space Support Team Tactical Set.	2500	0	0	0
Totals	5391	6769	9066	11040

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603007A - Manpower, Personnel and Training Advanced Technolo**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		8811	8070	6783	7024	7236	7271	7337	7396
792	PERSONNEL PERFORMANCE & TRAINING	4822	7112	6783	7024	7236	7271	7337	7396
79A	PERSONNEL & TRAINING ADV TECH INITIATIVES (CA)	3989	958	0	0	0	0	0	0

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 also exploits opportunities to enhance Current Force capabilities. The advanced technology development in personnel, training, and leader development conducted in this program provides the tools to retain the highest quality Soldiers; train and develop Soldiers to keep pace with technology and mission demands as they evolve; build effective teams and units; shape cultural mind-sets for joint operations; and understand and improve attitudes and motivation to enhance unit performance. One goal of this program is to develop technologies to reduce training and personnel costs and, at the same time, improve individual and unit performance by leveraging the advances in live, virtual, and constructive simulations. Another goal is to develop technologies to accelerate the processes associated with training and developing skills, knowledge, and capabilities, as well as, develop tools to sustain learning and retain skills over longer periods of time. This program leverages and coordinates with work at 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 U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	7288	6981	7166
Current Budget (FY 2006/2007 PB)	8070	6783	7024
Total Adjustments	782	-198	-142
Net of Program/Database Changes			
Congressional Program Reductions	-65		
Congressional Rescissions			
Congressional Increases	1000		
Reprogrammings			
SBIR/STTR Transfer	-153		
Adjustments to Budget Years		-198	-142

Change Summary Explanation:

One FY05 Congressional add totaling $1000 was added to the PE.

FY05 Congressional Add with no R-2A:
($958) Battle Command Team Training (BCTT) Program, Project 79A: The purpose of this one year Congressional add is to fund battle command team training. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603007A - Manpower, Personnel and Training Advanced Technolo**	**792**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
792	PERSONNEL PERFORMANCE & TRAINING	4822	7112	6783	7024	7236	7271	7337	7396

A. Mission Description and Budget Item Justification: The objective of this project is to develop, refine, 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 Force. The project, when feasible, exploits opportunities to enhance Current Force capabilities. Advanced technology development efforts include: designing new ways to efficiently develop collective training methods and materials; developing and demonstrating training methods and techniques that prepare battle commanders to operate in digitized, networked environments and that facilitate the use of embedded training technologies for Future Combat Systems (FCS); devising strategies to use distributed training technologies to conduct multi-site training, assessment, and feedback; and developing improved tools for selecting personnel for flight training. Other efforts focus on developing leader development tools that capitalize on the various synthetic environments, game technologies, and delivery media (web, Personal Digital Assistant (PDA), etc), 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 and mission readiness, and on determining the effects of organizational stabilization and increased operational tempo on unit cohesion and Soldier retention and readiness. This program leverages and coordinates with work at the Institute for Creative Technologies (ICT) and Simulation and Training Technology Center (STTC). Work in this PE is related to and fully coordinated with efforts funded in PE0602785. 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 U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Personnel Technology: In FY04, initiated a longitudinal assessment of the impact of personnel stabilization under Unit Manning on small-unit cohesion; and investigated tools and methods for leaders to use to improve unit climate and teamwork. In FY05, identify factors influencing small-unit cohesion in a stabilized personnel (unit) environment; assess the impact of operational tempo on Soldier attitudes and retention. In FY06, will continue longitudinal (i.e., over time) data collection to assess impact of personnel stabilization and conduct trend analyses to identify most critical factors that influence small unit cohesion; will develop a preliminary model of the effects of operational tempo on Soldier readiness; will develop new test battery to select individuals for Army flight training; will demonstrate improved tools that will more effectively assign aviators to aircraft. In FY07, based on longitudinal research findings will provide lessons learned to DAG-1 and HRC for improving the personnel stabilization process; will continue the analysis of factors that affect Soldier and leader attitudes and retention; will validate new tests for selecting individuals for Army flight training.	1199	1778	1695	1756
Training Technology: In FY04, determined the best combination of simulator and live-fire training to maximize small arms marksmanship proficiency; developed prototype training support packages and conducted trial implementations to expand/refine the Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) training techniques and collective performance measurement approaches; and assessed the use of PC-based games for tactics training. In FY05, demonstrate prototype tools to manage and adapt training for changing unit requirements; develop metrics for assessing the training effectiveness of single-user immersive interactive simulations. In FY06, will develop exemplar methods and measures for determining individual and collective preparedness for entry into full-scale networked tactical unit training; will develop instructional guidelines and learning models for single-user immersive interactive simulations and assess effectiveness. In FY07, will refine methods and tools for efficiently adapting networked training to emerging tactical tasks in the future operating environments (e.g., joint, expeditionary, and effects-based operations); and develop a learning model and the metrics for assessing training effectiveness of multi-player immersive interactive simulations.	2424	3556	3393	3512

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Leader Development Technology: In FY04, demonstrated mentoring programs and tools that help mid-level unit leaders train and assess leadership skills and adaptability in their subordinates; and demonstrated module for teaching critical thinking skills supported by automated coaching and on-line diagnostic and feedback techniques for company grade leaders. In FY05, determine the most effective methods for leaders to rapidly develop unit cohesion in times of personnel turbulence, stress, and changing operational requirements; evaluate web-based modules for training leaders' critical thinking; identify small group modifications to the "Think Like a Commander – Excellence in Leadership" (TLAC-XL) program and demonstrate computer-based coaching for experiential development of interpersonal skills (this is a cooperative effort with the Institute for Creative Technologies (ICT) to leverage their expertise in immersive simulation environments on the TLAC-XL program). In FY06, will complete and test three additional critical thinking modules; will evaluate and fine-tune Special Operations leader development products and tools for their application to conventional forces; will identify the critical interpersonal communications skills needed to work effectively in network-centric teams. In FY07, will expand instruction tools to enhance leader self awareness in the Future Force; will develop computer-based coaching modules for experiential development of interpersonal skills for Future Force leaders; will determine the key characteristics of effective virtual mentors to maximize learning from mission scenarios in virtual environments.	1199	1778	1695	1756
Totals	4822	7112	6783	7024

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603008A - Electronic Warfare Advanced Technology**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		58181	57662	45322	48050	42142	44231	48733	47083
TR1	TAC C4 TECHNOLOGY INT	12391	17025	22028	24407	15780	15994	16057	14168
TR2	DIGITAL BATTLEFLD COMM	36448	33352	23294	23643	26362	28237	32676	32915
TR8	C3 DEMONSTRATIONS (CA)	9342	7285	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The goal of this 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 Future Combat Systems (FCS) and 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. Adaptive Joint C4ISR Node (AJCN) Advanced Concept Technology Demonstrations (ACTD) makes a significant contribution to this program by providing 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 force spread over wide areas. 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.

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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	41760	47260	49687
Current Budget (FY 2006/2007 PB)	57662	45322	48050
Total Adjustments	15902	-1938	-1637
Net of Program/Database Changes			
Congressional Program Reductions	-1180		
Congressional Rescissions			
Congressional Increases	18600		
Reprogrammings			
SBIR/STTR Transfer	-1518		
Adjustments to Budget Years		-1938	-1637

Change Summary Explanation:

Three FY05 Congressional adds totaling $18600 were added to the PE.

FY05 Congressional adds with no R-2A:
($10549) Applied Communications and Information Networking (ACIN) Program, Project TR2: The purpose of this one year Congressional add is to fund the Applied Communications and Information Networking Program. No additional funding is required to complete this project.

($1918) Portable Emergency Broadband Systems (PEBS), Project TR8: The purpose of this one year Congressional add is to mature an in-building position location capability and extend the range to outdoor networks with a reachback capability. No additional funds are required to complete this effort.

($5370) Networking Environment for C3 Mobile Services (NECMS), Project TR8: The purpose of this one year Congressional add is to mature instrumented nodes for data collection, data transmission, and data storage/analysis. This project also matures an instrumented “war room” capability for network environment demonstration, testing, monitoring, and control. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603008A - Electronic Warfare Advanced Technology**	**TR1**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
TR1	TAC C4 TECHNOLOGY INT	12391	17025	22028	24407	15780	15994	16057	14168

A. Mission Description and Budget Item Justification: This project matures and demonstrates key communications, mobile networking, and information assurance technologies for the dismounted Soldier, future combat networks, 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 Communications program 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 FCS manned and unmanned systems under the size, weight, power consumption, and safety constraints of embedded JTRS Cluster 5 Small Form Fit (SFF) platform environments. Advanced Antennas matures a family of efficient and affordable antennas across a wide spectrum (30 MHz to 44 GHz) for increased throughput and range. This will include a robust and dynamic reachback capability to enable Global Information Grid (GIG) connectivity. The Tactical Wireless Network Assurance (TWNA) program 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 program matures and demonstrates mobile data security solutions and protection of secure database elements. TWNA leverages and matures a variety of security efforts from DARPA and the Army Research Lab (ARL). The Multi-Dimensional Assured, Robust, Communications for an OTM (MARCON-I) Network effort matures and integrates directional networking technologies that address the barriers of insufficient bandwidth and limited spectrum to provide the warfighter with a robust, efficient, high capacity Anti-Jam Low Probability of Intercept (AJ/LPI) directional communications network. The Communications Planner for Operational and Simulation Effects with Realism (COMPOSER) program 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 will provide an open and scalable communications planning solution for dynamic OTM networks, providing the commander with the ability to ensure full network connectivity throughout the battle.

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 2004	FY 2005	FY 2006	FY 2007
- JTRS Squad-Level Communications: In FY04, completed implementation of lightweight Core Framework and integration with Soldier Radio Waveform (SRW) software application; developed software programmable modem and baseband processor with radio frequency agile front-end prototype environment and validated SRW design in laboratory and field environments. In FY05, complete SRW software application development, integrate in prototyping environment to validate dismounted Soldier voice and data communications services, and demonstrate interoperability with manned and unmanned systems through implementation of 2-independent transceiver gateway configuration; interface SRW with JTRS Cluster 1 heterogeneous network software application core and implement extensions to support FCS Unmanned Aerial Vehicle and Unmanned Ground Vehicle functions; release SRW application software to initiate porting to JTRS Cluster 1. In FY06, will develop SRW enhancements to validate dismounted Soldier voice and data communications services with single transceiver channel gateway configuration; will release SRW application software to initiate porting to JTRS Cluster 5, will participate in Future Force Warrior ATD and FCS Unit of Action (UA) experimentation. In FY07, will finalize SRW effort; will complete porting to JTRS Clusters 1 and 5; and will transition the SRW to the JTRS Joint Program Office.	1500	8550	11000	10000
- Advanced Antennas: In FY04, completed testing of Phase 2 body-wearable prototypes, Phase 1 3-port multiband prototypes and Phase 1 low profile prototypes. In FY05, perform technical evaluation and integration for Multiband Phased Array antenna technologies to maintain OTM SATCOM links over rolling terrain; mature the body-wearable, aviation and low profile antennas to improve performance and conduct Radio Frequency (RF) performance; conduct RF safety evaluation. In FY06, will complete development of body-wearable, low profile and rotary wing aviation antennas.	1000	2866	2800	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Tactical Wireless Network Assurance (TWNA): In FY05, mature and evaluate Tactical Public Key (TPK) enabling technologies to ensure secure user access to platforms and services; mature and test wireless intrusion detection technologies to detect cyber attacks against distributed mobile hosts and networks; mature and test database access control and authentication of mobile data technologies that restrict unauthorized modification to software on mobile platforms. In FY06, will provide intrusion detection algorithms for FCS UA to deter intruders and recognize attempts to attack/exploit Mobile Ad-hoc Networks (MANETs); will mature and test TPK enabling capabilities in a simulated MANET environment; will mature and perform testing of adaptive security management technologies that effectively reduce the time needed by a user to detect, react and respond to attacks/exploits within mobile networks. In FY07, will mature intrusion detection system framework and integrate with security management capability; will mature and perform testing of adaptive/distributive security management technologies that allow rapid response to intrusions within MANETs; will mature and test mobile agent technologies that restrict unauthorized modification to mobile code used on MANET platforms; will mature certificate revocation capability within TPK framework to reduce impact of security overhead on MANETs; will provide demonstration encapsulating matured wireless security capabilities.	450	2795	4000	4865
- Multi-Dimensional Assured, Robust, Comms for OTM Network (MARCON-I): In FY04, completed architecture design trades and technology analysis for directional networking; conducted feasibility studies for link selection. In FY05, perform system design and development of link selection and directional networking technologies; conduct Modeling & Simulation (M&S) effort to support link selection and directional networking development efforts. In FY06, will perform initial implementation and controlled environment testing of link selection algorithms; will conduct M&S with initial performance results of the algorithms. In FY07, will mature and demonstrate link selection technologies in an outdoor/operationally relevant environment on representative platforms to assess protocol maturity; will perform M&S and compare M&S results to hardware demonstration results to verify completion of protocol development.	500	2814	3952	8698
- Communications Planner for Operational and Simulation Effects with Realism (COMPOSER): In FY06, will mature Communications Effects Simulator with predicted Network Planner and a dynamic 2D/3D visualization, then integrate the tools into the Battle Lab Collaborative Simulation Environment and Modeling Architecture for Technology and Research Experimentation. In FY07, will integrate COMPOSER technologies with applications from the Project Manger Warfighter Information Network-Tactical (PM WIN-T) and Program Manager Unit of Action Network Systems Integration (PM UA NSI) programs.	0	0	276	844

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) ATD: In FY04, performed integration of all MOSAIC networking and Quality of Service (QoS) technologies; incorporated MOSAIC networking and QoS technologies into the Fort Dix C4ISR Experiment for validation of MOSAIC automatic network initialization/configuration, re-configuration and ad-hoc mobility exit criteria; integrated MOSAIC QoS technologies into a high assurance internet protocol encryption compliant networking solution for transitionability.	6941	0	0	0
- On-The-Move (OTM) Satellite Communications (SATCOM): In FY04, conducted the Technology Readiness Level (TRL) 6 demonstration of the Wideband OTM blockage mitigation capability and transitioned to Warfighter Information Network-Tactical (WIN-T) and High-Capacity Communications Capability (HC3); integrated Wideband OTM capability into the FY04 C4ISR OTM experiment; matured Milstar OTM blockage mitigation approach for networks of terminals.	2000	0	0	0
Totals	12391	17025	22028	24407

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603008A - Electronic Warfare Advanced Technology**	**TR2**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
TR2	DIGITAL BATTLEFLD COMM	36448	33352	23294	23643	26362	28237	32676	32915

A. Mission Description and Budget Item Justification: 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, to include Future Combat Systems (FCS), 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 two 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 FCS integrated on-the-move lethal force structure; and 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. Several key programs support these goals. The C4ISR OTM test bed provides a venue for the experimentation of emerging C4ISR technologies and architectures that will increase the survivability and lethality of Future Force platforms. 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 Brigade Combat Team) modernization. Adaptive Joint C4ISR Node (AJCN) ACTD for mobile airborne communication nodes seeks to provide assured communications for the Unit of Action (UA) and also has the capability to perform signals intelligence, information warfare and electronic attack missions simultaneously. Network Sensors for the Future Force (NSFF) Communications will enable adaptable, self healing, low power, integrated communication nodes for unmanned sensor networks. The Multi-Dimensional Assured, Robust, Communications for an OTM Network (MARCONi) will integrate directional networking protocols with prototype hardware platforms in support of Technology Readiness Level (TRL) 6 field testing. 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/counter Improvised Explosive Devices (IED), 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 improve Cluster 1 Joint Tactical Radio range, throughput and reliability 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 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 2004	FY 2005	FY 2006	FY 2007
- C4ISR On-The-Move Experiment: In FY04, conducted live Joint experiments with integrated C4ISR technologies focused on intelligence surveillance and reconnaissance fusion, a common operating picture, weapons-target pairing, combat identification, and rapid battle damage assessment; evaluated the feasibility of vertical maneuver concepts equipped with emerging Future Force C4ISR technologies. In FY05, conduct experiments to mature concepts and evaluate risk areas from the FCS program to support program milestone decisions and applicability of technologies/systems to meet the acceleration of future force C4ISR concepts to current force requirements; integrate a surrogate (Future Force) C4ISR architectural framework to examine battle command, communications, and intelligence, reconnaissance and surveillance interdependencies integrating Army Science and Technology (S&T), DARPA, National Laboratory, Joint Service and Coalition capabilities. In FY06, will continue to mature and refine the C4ISR framework for system of systems trial experiments, and support TRADOC Army Concept Development Experiment Project priorities; will exercise first instances of the emerging Army Battle Command capabilities to inform and establish a baseline that confirms the level of interoperability and connectivity available for UA, Unit of Employment, Joint, coalition, national and sustaining base C4ISR information assets. In FY07, will revise experimentation, planning and lessons learned analyses to support the establishment of multiple C4ISR baselines for system interdependencies and integration investigation from which capability gaps can be surfaced and mitigated; will demonstrate application of network mining and its tools and associated technologies within the C4ISR architecture.	11000	10000	13500	12800

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Adaptive Joint C4ISR Node (AJCN) ATCD: In FY04, developed prototype payload and demonstrated its functional capability; installed the prototype payload on an Army aircraft and conducted flight demonstration; addressed top-level metrics by performing an initial capability in four functional areas including Communications, Signals Intelligence, Electronic Warfare, and Information Operations; performed Initial Joint Military Utility Assessment (IJMUA) during the flight-testing. In FY05, mature payload functionalities, complete payload integration, and demonstrate three payloads; install payloads and antennas on the Air Force's Paul Revere and two Army Hunter aircrafts; conduct flight tests to verify operation of payload and AJCN network at first JMUA exercise. In FY06, will conduct second JMUA exercise and finalize CONOPS, TTPs, training package, and recommendations to Doctrine, Organization, Training, Materiel, Logistics, Personnel and Facilities; will refine system performance requirements; will conduct Extended User Evaluation (EUE) and provide sustainment support for leave behind equipment. In FY07, will conduct porting of software waveforms to the payloads as they become available from JTRS Joint Program Office (JPO); will continue with EUE and sustainment for leave behind equipment.	10000	8850	1950	1120
- Networked Sensors for the Future Force (NSFF) Communications: In FY04, demonstrated a 10 node robust, self-healing, jam-resistant, Low Probability of Intercept/ Low Probability of Detection, energy-efficient network with networking protocols for internode unmanned ground sensor communications with a range of 200 meters and sensor to gateway connectivity to 3 kilometers in flat open terrain; matured low cost, JTRS software communications architecture soldier radio waveform sensor communications breadboard models. In FY05, simulate a 100 node network to determine large sensor network effectiveness; integrate and test a 50-node network to demonstrate sensor network capabilities and to validate the simulation; demonstrate communications range 200-400m and sensor connectivity of 3-10km depending on sensor type and terrain.	1700	3962	0	0
- Multi-Dimensional Assured, Robust, Communications for an OTM Network (MARCONi): In FY06, will mature directional networking technologies and conduct initial functionality testing. In FY07, will conduct interim demonstration of directional networking technologies; assess protocol maturity and compare test results obtained against expect performance outputs from M&S studies.	0	0	2872	2680
- C3OTM Network Mining: In FY06, will mature algorithms, intelligent agent technologies and decision aids that exploit individual and combined network sources to enhance countermine/counter IED and rapid BDA; will validate methodologies in the context of the C4ISR OTM experimentation. In FY07, will evaluate networked target identification and situation awareness for improved CID capability by testing and demonstrating at the C4ISR OTM experimentation.	0	0	3865	5311

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Radio Enabling Nextgen Applications (RETNA): In FY06, will identify, evaluate, and adapt emerging commercial technologies for military application; will mature a pre-MIL-qualified Wideband Power Amplifier (WBPA) Line Replacement Unit (LRU) and test in a JTRS Cluster 1 test bed, to enhance current range and link closure performance for ground applications; apply passive Graphite Foam (PGF) technology, used to dissipate heat from Cluster 1 thermal hot spots to a selected Cluster 1 LRU. In FY07, will mature and transition a Form, Fit, and Function military-qualified WBPA LRU with PGF to the JTRS Cluster 1 Program for its Low Rate Initial Production (LRIP); will mature Rotary Wing (RW) Electro Magnetic Interference (EMI) filter to reduce size, weight, and power, ensuring the required filter performance compliance and focusing on miniaturization.	0	0	1107	1732
- Multifunctional On-the-Move Secure Adaptive Integrated Communications (MOSAIC) ATD: In FY04, conducted ATD exit demonstration with Quality of Service (QoS), ad-hoc mobility, and advantaged node technologies consisting of 22 nodes covering 20 square miles with MOSAIC ad hoc mobility, heterogeneous QoS, and advantaged node technologies hosted on surrogate JTRS radio/router platforms, commercial radios/routers, satellite communications terminals, and an airborne node; demonstrated multiple Internet Protocol applications to show mixed traffic types (voice, video, and data) sharing the same network/resources.	4118	0	0	0
- Applied Communications & Information Networking (ACIN): In FY04, this one year Congressional add matured and demonstrated emerging commercial communications technologies in the areas of Information Assurance, Software Defined Radio, Modeling and Simulation, Subterranean Communications, and Ultra Wideband Amplifier. No additional funds were required to complete this effort.	9630	0	0	0
- Applied Communications & Information Networking (ACIN): In FY05, this one year Congressional add is to mature and demonstrate commercial communications technologies in the areas of high power wideband amplifiers, Ku/Ka-Band SATCOM subsystem transceiver modules, predictive network planning, IPv4 to IPv6 conversion, and software defined radios modeling and simulation. No additional funds are required to complete this effort.	0	10540	0	0
Totals	36448	33352	23294	23643

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	15341	26900	19982	20710	22897	22932	23398	23872
HB5	IMMERSIVE ENVIRONMENTS DEMONSTRATIONS (CA)	3113	2397	0	0	0	0	0	0
S28	INSTITUTE FOR CREATIVE TECHNOLOGY (ICT)-ATD	244	1571	5142	5241	5252	5249	5354	5460
S29	MODELING & SIMULATION - ATD	2183	2785	1507	1883	4029	4075	4166	4259
S30	JOINT VIRTUAL BATTLESPACE	3464	0	0	0	0	0	0	0
S31	RDEC FEDERATION	3418	12956	13333	13586	13616	13608	13878	14153
S33	TRAINING AND SIMULATION SYSTEMS INITIATIVES (CA)	2919	7191	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element 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 Future Combat Systems (FCS) and dismounted warrior systems. The Research Development and Engineering Command (RDEC) Federation 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 RDEC Federation 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. The RDEC Federation combines the architecture work previously performed in Project S30 and the modeling work previously performed in Project S31 into a single coordinated effort. Projects HB5 and S33 fund Congressional special interest items. Work in this program element is related to and fully coordinated with efforts in PE 0603238A, Project 177 (JT ALS PS DEMO); PE 0602308A, PE0603001A, Project 545 (Force Projection Logistics); and PE0601104A, Project J08 (Institute for Creative Technology). This PE was established to transition maturing technology from PE0601104A, Project J08 (Institute for Creative Technology) and PE 0602308A, Project C90 (Advanced Distributed Simulation) and Project D02 (Modeling and Simulation for Training and Design) into demonstration 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 is performed by the Research Development and Engineering Command (RDE Command), Orlando, FL, and Fort Belvoir, VA.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	18072	20736	21063
Current Budget (FY 2006/2007 PB)	26900	19982	20710
Total Adjustments	8828	-754	-353
Net of Program/Database Changes			
Congressional Program Reductions	-401		
Congressional Rescissions			
Congressional Increases	10000		
Reprogrammings			
SBIR/STTR Transfer	-771		
Adjustments to Budget Years		-754	-353

Change Summary Explanation:

Three FY05 Congressional adds totaling $10000 were added to this PE.

FY05 Congressional Adds with no R-2A:
($5754) CAVE Automated Virtual Environment, Project S33: The purpose of this one year Congressional add is to mature research in the use of the Cave Automated Virtual Environment to support simulation modeling for acquisition, requirements and training for new system development and test. No additional funding is required to complete this project.

($1439) Combat Trauma Patient Simulator System, Project S33: The purpose of this one year Congressional add is to conduct research on a combat trauma patient simulator system. No additional funds are required to complete this project.

($2398) Institute for Creative Technologies – Joint Fires and Effects Training System, Project HB5: The purpose of this one year Congressional add is to fund research on joint fires and effects training. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**	**S28**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
S28	INSTITUTE FOR CREATIVE TECHNOLOGY (ICT)-ATD	244	1571	5142	5241	5252	5249	5354	5460

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 transition basic and applied research from PE0601104A, Project J08 (Institute for Creative Technology) and PE 0602308A, Project D02 (Modeling & Simulation for Training & 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), Orlando, FL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Immersive Techniques - In FY04, investigated methods to integrate immersive evaluation techniques into training and leader development technology demonstrations that incorporated advanced artificial intelligence techniques for after action review and enhanced sound capability for individual soldier simulations. In FY05, use immersive environments created for training simulation systems to facilitate the integration of new algorithms and techniques into scenario development and after action review processes that support self-assessment of mission accomplishment. In FY06, will mature initiatives in artificial intelligence and immersive technologies that enable intelligent agent mentoring and coaching capabilities; will demonstrate a prototypical highly immersive multi-sensory environment that provides mixed reality (real and synthetic) objects for training and mission rehearsal; will mature the techniques and interfaces to support interoperability between the virtual human enabled immersive environment and the One Semi-Automated Forces system. In FY07, will demonstrate the integration of rapid scenario development techniques, virtual humans and intelligent agent mentoring and coaching capabilities in both a single trainee and small group collaboration enabled immersive simulation learning environment; will demonstrate the integration of these tools for implementing a learning environment with the One Semi-Automated Forces simulation.	244	1571	5142	5241
Totals	244	1571	5142	5241

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**	**S29**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
S29	MODELING & SIMULATION - ATD	2183	2785	1507	1883	4029	4075	4166	4259

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 systems to include Future Combat Systems (FCS) and the 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 FCS 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), Orlando, FL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Embedded Techniques. - In FY04, developed an improved embedded simulation engine that merges constructive and virtual simulations to provide a streamlined embedded simulation capability for the FCS Unit of Action; demonstrated an intelligent structured training prototype to provide providing embedded computerized instruction decreasing the logistical demands for instructors to oversee all training exercises. Integrated and demonstrated technology for constructive and virtual simulation from joint armed services to demonstrate the learning and training needed to significantly increase the training capability of the joint forces. In FY05, integrate prototype mounted and dismounted soldier embedded training systems to demonstrate small unit training and mission rehearsal while identifying interoperability issues with embedded training for vehicles and dismounted soldiers. Develop initial interface standards for connecting external agents (real, simulated or computerized) to address performance and training effectiveness of advanced technologies to minimize impact of integration into the Joint National Training Capability. In FY 06, will mature and demonstrate an integrated mounted and dismounted embedded training system that includes collaborative mission planning, rehearsal and after action review capabilities. In FY 07, will create a fully embedded soldier prototype capability supporting future Soldier systems demonstrating a man wearable, integrated live, virtual, and constructive training and mission rehearsal capability.	2183	2785	1507	1883
Totals	2183	2785	1507	1883

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**	**S31**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
S31	RDEC FEDERATION	3418	12956	13333	13586	13616	13608	13878	14153

A. Mission Description and Budget Item Justification: During FY04, Projects S30 (Joint Virtual Battlespace) and S31 (RDEC Federation) began the work to provide the foundation for the Modeling Architecture for Technology, Research, and EXperimentation (MATREX) modeling and simulation (M&S) architecture. Beginning in FY05 Project S30's core integrated modeling and simulation architecture development efforts and Project S31's collaborative environment and M&S component development efforts have been merged under this project to create a single integrated MATREX development effort. The MATREX architecture integrates live, virtual, and constructive simulations in a distributed joint battle space. This enables the determination of the best and most cost effective system-of-systems designs as compared to individual component solutions. The integrated M&S architecture supports the examination of joint C4ISR concepts and system-of-systems solutions by facilitating studies and demonstrations that assess the operational impact of joint Network-Centric Warfare (NCW) force concepts through a simulation environment that adequately models the current and Future Force (FF) tactical network systems, the information that flows through that network, and the impact of this information on force effectiveness. Efforts include the creation of a distributed virtual laboratory that will be used to conduct collaborative distributed simulation experiments, studies, and analysis to facilitate acquisition decisions using the Simulation and Modeling for Acquisition, Requirements and Training (SMART) process, as well as the development and selection of "best of breed" high-resolution engineering-level simulation model components to support the evaluation of Joint Forces and FF concepts to include Future Combat Systems (FCS) and 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 FCS Brigade Combat Team (BCT) within the context of a Unit of Employment (UE), enhancing the user's ability to study the Measures of Effectiveness of interest. Additionally, MATREX will develop a Distributed Virtual Laboratory (DVL) to network geographically dispersed M&S assets, and therefore reduce the Army's cost of developmental testing, integration, and experimentation. The DVL will provide a continuously available secure M&S environment that facilitates technical and subject matter experts working together from remote, distributed labs. 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), Fort Belvoir, VA.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603015A - Next Generation Training & Simulation Systems**	**S31**

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Modeling Architecture for Technology, Research, and EXperimentation (MATREX). In FY04, integrated and tested the MATREX baseline simulation architecture incorporating One Semi-Automated Force (OneSAF) Objective Testbed in a networked environment that connected remote sites; developed and integrated capability to model battlefield communication networks to evaluate Network Centric Warfare (NCW) concepts; and delivered initial two versions of MATREX to the FCS Lead Systems Integrator (LSI) for incorporation as the foundation of FCS Systems of Systems Virtual Framework (SVF). In FY05, deliver classified version of MATREX to FCS LSI to establish initial classified environment for SVF development; establish baseline High Level Architecture (HLA) based end-to-end simulation environment for Current Force Modularity, FCS Spirals, and Future Force experimentation, integration, and evaluation; and initiate Model Driven Architecture (MDA) development. In FY06, enable FCS development, integration, test & evaluation (T&E) for current, future, and Spiral 1 development and integrated NCW (Network, Effects, Maneuver, and ISR) by delivering critical simulation architecture necessary for the development of initial FCS Integration & Verification Phase 0 architecture needed to support critical FY06 and FY07 program milestones; implement MDA that enables disparate model developments to be used across M&S architecture paradigms; and provide capabilities to FCS LSI in direct support of FCS Experiment 1.1. In FY07, implement joint service aspects of integrated NCW end-to-end simulation capabilities that support joint programmatic decisions throughout a systems life cycle (concept exploration, design, integration, T&E, maintenance & logistics, cost, and training); and transition MDA and integrated tool suite to support TRADOC, FCS, and other Army acquisition programs.	3418	12956	13333	13586
Totals	3418	12956	13333	13586

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603103A - Explosive Demilitarization Technology**	**D51**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
D51	EXPLOSIVES DEMIL TECH	24180	18405	9865	10241	10293	10508	10901	11118

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 by 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 2004	FY 2005	FY 2006	FY 2007
Resource Recovery and Reuse (R3): In FY 04, continued development of explosives/propellant detection with Near-Infrared (NIR) Technology; developed sporting powder formulations; demonstrated Explosive D conversion to picric acid. In FY 05, increase NIR calibration library for propellants and perform field demonstration of NIR explosives detection unit; continue development of sporting powder formulations; optimize Explosive D conversion process; validate propellant conversion technology; design analysis of alternatives for missile demilitarization. In FY 06, will continue development of calibration curves for the NIR propellant scanner; complete demonstration/validation of NIR explosives detection unit; initiate conversion of gun propellant to small arms ammunition (SAA) propellant for military applications; validate Explosive D conversion process; design and fabricate propellant conversion technology for optimal throughput; initiate prototype design for missile demilitarization. In FY 07, will transition NIR explosive detection unit; continue development of SAA propellant formulations; transition Explosive D conversion process; initiate development of process for conversion of Explosive D to higher value products; demonstrate optimized propellant conversion technology; complete prototype design for missile demilitarization; and continue Joint Program integration.	3520	5627	3700	4092
Advanced Destruction: In FY04, demonstrated enhanced stationary contained detonation technology (CDT); modified transportable contained detonation unit; demonstrated transportability of confined burn technology. In FY 05, incorporate performance enhancements to the stationary CDT based on prior demonstrations; initiate demonstration of transportable CDT; test system operability of confined burn technology. In FY 06, will demonstrate/validate enhanced stationary CDT; continue demonstration of transportable CDT; demonstrate confined burn technology. In FY 07, will transition stationary CDT; validate and transition transportable CDT; and enhance feed system for confined burn technology.	2280	728	1265	1000
Waste Stream treatment: In FY 04, incorporated enhancements to the Super Critical Water Oxidation (SCWO) technology; conducted design evaluation of Molten Salt Oxidation (MSO) unit; designed and fabricated advanced decontamination capability. In FY 05, demonstrate enhanced SCWO technology; complete fabrication and initiate demonstration of MSO. In FY 06, will validate and transition SCWO technology; complete demonstration and continue advanced development of MSO for explosives. In FY 07 will conduct pilot demonstration of advanced MSO.	1920	1553	4000	3000

Accomplishments/Planned Program A(continued)	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Munitions Disassembly: In FY04, continued efforts in the areas of robotic disassembly of projectiles; demonstrated and validated robotic disassembly work cells matured for the Artillery Delivered Anti-personnel Mine (ADAM) projectile. In FY05, transition robotic disassembly for the ADAM projectile; optimize water jet cutting parameters for medium caliber projectiles. In FY06, will complete demonstration/validation of robotic disassembly work cell for 8in RAP; design and fabricate waterjet prototype for medium caliber projectiles. In FY07, will transition robotic disassembly work cell for 8In RAP and initiate design for disassembly of 155mm RAP; complete fabrication and initiate demonstration/validation of waterjet prototype for medium caliber projectiles; and initiate advanced cutting for disassembly of CBUs/submunitions.	660	717	800	1999
Advanced Removal: In FY05, optimize induction heating parameters for medium caliber projectiles. In FY 06, will design and fabricate induction heating prototype for medium caliber projectiles. In FY 07, complete fabrication and initiate demonstration/validation of induction heating prototype for medium caliber projectiles.	0	280	100	150
The purpose of this one year Congressional add is to support an integrated Cryofracture/Plasma Arc capability. No additional funds are required to complete this project.	0	4500	0	0
The purpose of this one year Congressional add is to support the Missile Recycling Center capability. No additional funds are required to complete this project.	0	1400	0	0
The purpose of this one year Congressional add is to support propellant conversion to fertilizer. No additional funds are required to complete this project.	0	1500	0	0
The purpose of this one year Congressional add is to support the Thin Layer Chromatography technology. No additional funds are required to complete this project.	0	2100	0	0
The purpose of this one year Congressional add is to support the Missile Recycling Center at Anniston. No additional funds are required to complete this project.	2100	0	0	0
The purpose of this one year Congressional add is to support the Tactical Missile Reuse/Demil at Letterkenny. No additional funds are required to complete this project.	1750	0	0	0
The purpose of this one year Congressional add is to support the Reclamation of Class 1.1 Rocket Propellant. No additional funds are required to complete this project.	2000	0	0	0
The purpose of this one year Congressional add is to support the HXM Requalification Program. No additional funds are required to complete this project.	1000	0	0	0
The purpose of this one year Congressional add is to support the Explosive Demil Technology Program. No additional funds are required to complete this project.	1000	0	0	0
The purpose of this one year Congressional add is to support the Thin Layer Chromatography technology. No additional funds are required to complete this project.	2100	0	0	0

Accomplishments/Planned Program B(continued)	FY 2004	FY 2005	FY 2006	FY 2007
The purpose of this one year Congressional add is to support the Innovative Demil Technology Program. No additional funds are required to complete this project.	2100	0	0	0
The purpose of this one year Congressional add is to support the Demilitarization of Obsolete Munitions. No additional funds are required to complete this project.	1750	0	0	0
The purpose of this one year Congressional add is to support the Demilitarization and Destruction of Conventional Ammunition. No additional funds are required to complete this project.	1000	0	0	0
The purpose of this one year Congressional add is to support the Bluegrass Supercritical Water Oxidation (SWCO) Program Demonstration. No additional funds are required to complete this project.	1000	0	0	0
Totals	24180	18405	9865	10241

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	9706	9865	10042
Current Budget (FY 2006/2007 PB)	18405	9865	10241
Total Adjustments	8699	0	199
Net of Program/Database Changes			
Congressional Program Reductions	-272		
Congressional Rescissions			
Congressional Increases	9500		
Reprogrammings			
SBIR/STTR Transfer	-529		
Adjustments to Budget Years			199

Change Summary Explanation:

Four FY05 Congressional adds totaling $9500 were added to this PE. Descriptions are included under Project D51 in this R-2 Exhibit.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603105A - MILITARY HIV RESEARCH**	**H29**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H29	MED PROTECT AGNST HIV	13708	13552	6842	7131	7145	7143	7285	7430

A. Mission Description and Budget Item Justification: This project supports the medical technology area of the Future Force by conducting concept exploration of candidate vaccines to include safety and efficacy in model systems and to prepare and conduct 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. HIV research is focused on the following areas: diagnosis, natural history, epidemiology, and vaccine development. Preclinical trials and Phase 1 and 2 clinical trials are performed as required for vaccine licensure with the U.S. Food and Drug Administration (FDA). This program is jointly managed through an Interagency Agreement by the U.S. 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 goverment organizations. Work is related to, and fully coordinated with work funded in PE 0602787. 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 Walter Reed Army Institute of Research, Silver Spring, MD and its overseas laboratories; and the Naval Medical Research Center, Silver Spring, MD and its overseas laboratories. Most work is conducted under a cooperative agreement with the Henry M. Jackson Foundation, Rockville, MD.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
In FY04, identified appropriate populations for clinical trials for development of selected candidate vaccines in East Africa; established diagnostic capabilities needed to differentiate vaccine-induced immune response from HIV infection in clinical trials; conducted preclinical studies of candidate HIV vaccines in animal models to determine safety and induction of immune response before studies are begun in humans; conducted a multicenter clinical study to investigate HIV drug resistance for clinical trials. In FY05, continue clinical trials of DNA/Adenoviral HIV vaccine(s) in East Africa and other new and improved HIV vaccine candidates; continue to identify appropriate populations for system development and demonstration (SDD) of selected candidate vaccines in East Africa; establish further diagnostic capabilities needed to differentiate vaccine-induced immune response from HIV infection in clinical trials, improve tests needed to assess HIV vaccine-induced immune responses; continue to conduct preclinical studies of candidate HIV vaccines in animal models to determine safety and induction of immune response before studies are begun in humans; continue to conduct a multicenter clinical study to investigate HIV drug resistance; conduct Phase 2 clinical testing of HIV vaccine candidates for transition to SDD if appropriate. In FY06, will evaluate the immunogenicity/efficacy of best vaccine candidates in Phase 2/3 clinical trials as appropriate and other activities required for vaccine development and testing such as assay improvement, preclinical testing, Investigational New Drug application writing and submission, and clinical data analysis. In FY07, will continue the clinical testing and support activities as dictated by the testing results and the FDA.	6502	6361	6842	7131
This one year Congressional add funds additional development and preclinical testing of a DNA based vaccine candidate co-developed with the National Institute of Allergy and Infectious Diseases, as well as preparation for clinical trials of this vaccine at several African field test sites requiring the establishment of clinics and laboratory facilities and training of personnel to conduct these trials.	7206	7191	0	0
Totals	13708	13552	6842	7131

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603105A - MILITARY HIV RESEARCH**	**H29**

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	6641	6842	6993
Current Budget (FY 2006/2007 PB)	13552	6842	7131
Total Adjustments	6911	0	138
Net of Program/Database Changes			
Congressional Program Reductions	-199		
Congressional Rescissions			
Congressional Increases	7500		
Reprogrammings			
SBIR/STTR Transfer	-390		
Adjustments to Budget Years			138

Change Summary Explanation:

One FY05 Congressional add totaling $7500 was added to this PE.

FY05 Congressional add with no R-2A:
($7193) Test, Treatment and Preventive Vaccines, Project H29. The objective of this one year Congressional add is to fund applied HIV research. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603125A - Combating Terrorism, Technology Development for**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		8480	8034	6306	7399	7997	8169	8167	7656
DF1	SURVIVABILITY & DENIAL	4783	3241	0	0	0	0	0	0
DF2	DETERRENCE, INDICATION & WARNINGS	1751	0	0	0	0	0	0	0
DF3	CONSEQUENCE MANAGEMENT & RECOVERY	1946	4793	0	0	0	0	0	0
DF5	AGILE INTEGRATION & DEMONSTRATION	0	0	6306	7399	7997	8169	8167	7656

A. Mission Description and Budget Item Justification: The objective of this program element is to mature and demonstrate advanced survivability engineering 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. Base Camp Protection, Project DF1, demonstrates a survivability planning capability and lightweight low-cost blast/ballistic protective measures. This will increase base camp survivability of personnel and equipment against advanced conventional weapons and terrorist threats, reduce logistics requirements, and enhance the capability of the Future Force in low-intensity conflicts and peacekeeping operations. Projects DF2 and DF3 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 U.S. Army Engineer Research and Development Center headquartered at Vicksburg, Mississippi and Research Development and Engineering Command (RDECOM), Ft. Belvoir, Virginia.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	3383	0	0
Current Budget (FY 2006/2007 PB)	8034	6306	7399
Total Adjustments	4651	6306	7399
Net of Program/Database Changes			
Congressional Program Reductions	-118		
Congressional Rescissions			
Congressional Increases	5000		
Reprogrammings			
SBIR/STTR Transfer	-231		
Adjustments to Budget Years		6306	7399

Change Summary Explanation:
FY06 - Increased funding ($6306K) funds new project DF5, Agile Integration, Demonstration, & Experimentation (AIDE) program to accelerate technologies with high payoff to address current operational shortfalls and assists accelerated delivery of Future Force oriented projects to current operations.
FY07 - Increased funding ($7399K) funds new project DF5, Agile Integration, Demonstration, & Experimentation (AIDE) program to accelerate technologies with high payoff to address current operational shortfalls and assists accelerated delivery of Future Force oriented projects to current operations.

One FY05 Congressional add totaling $5000 was added to this PE.

FY05 Congressional add with no R-2A:
($4795) Advanced Mobile Micro Grid Program, Project DF3. The purpose of this one year Congressional add is to fund research on an advanced mobile micro grid program. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603125A - Combating Terrorism, Technology Development for**	**DF5**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
DF5	AGILE INTEGRATION & DEMONSTRATION	0	0	6306	7399	7997	8169	8167	7656

A. Mission Description and Budget Item Justification: This project focuses on exploiting maturing technology development efforts at The Army Research Laboratory (ARL) and Research Development and Engineering Centers (RDECs) to address emerging or already identified warfighter requirements. This project would identify and work with Labs and RDECs to address the critical maturation issues necessary to make identified technologies viable candidates for transition to an operational environment. Short term maturation could include, but is not limited to, accelerating the technology development schedule and/or performing detailed safety & validation tests in a field/operational environment testing to improve technology readiness. While not limited to this area, a major effort under this project supports the accelerated maturation of counter IED capabilities (detection, surveillance of deployment and disruption / destruction of threat) for transition into an operational environment. 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, Virginia.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603125A - Combating Terrorism, Technology Development for**	**DF5**

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Agile Integration and Demonstration Efforts - In FY06, in conjunction with the Army Labs, RDECs, and the U.S. Army Training and Doctrine Command, will identify emerging requirements and capability gaps, assess technologies that fill capability gaps, prioritize potential solutions and mature technology efforts that may have direct impact on emerging warfighters needs that requires a short term (4 to 18 months) maturation prior to becoming a reasonable candidate for transition to operational use. Expected development efforts include tagging, tracking and surveillance technologies to provide “backtrack” capability to help identify the launch point of threats and IED events; mature and validate tracking algorithms through evaluations in an operationally relevant environment, and evaluate sensor to platform integration. In FY07, will refine response time to pick-up targets from increased distances; miniaturize existing sensors; and validate required performance through operational tests.	0	0	6306	7399
Totals	0	0	6306	7399

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603238A - Global Surveillance/Air Defense/Precision Strike T**	**177**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
177	JT ALS PS DEMO	12205	10284	12111	12529	13145	13342	13836	13937

A. Mission Description and Budget Item Justification: The Joint Programs Sustainment and Development (JPSD) Project Office, an element of the Program Executive Office, Intelligence, Electronic Warfare and Sensors, provides creative and innovative solutions to operational problems. In response to the requirements of Combatant Commanders and the Department of Defense, JPSD integrates maturing technologies, commercial hardware and software and new tactics, techniques and procedures to facilitate development of capabilities in the areas of Command, Control, Communications, and Computers (C4), and Intelligence, Surveillance and Reconnaissance (ISR). JPSD uses non-traditional acquisition approaches, such as Advanced Concept Technology Demonstrations, Simulation Based Acquisition, rapid prototyping, and other novel approaches to accelerate the maturation and transition of key capabilities to the Army Future Force and future elements of the Joint Warfighting Force.

The Joint Intelligence Surveillance and Reconnaissance (JISR) ACTD will provide a significantly enhanced capability to disadvantaged users to dominate situation awareness through the use of a Web-based thin client browser and information agents by means of more timely effective and timely access, integration, and visualization of relevant multi-service and multi-echelon intelligence surveillance and reconnaissance information (ISR).

The Interferometric Synthetic Aperture Radar (IFSAR) Mapping ACTD will demonstrate a capability to rapidly collect and generate high-resolution terrain information (HRTI) data from a mid-altitude unmanned aerial vehicle (UAV). Theater-wide, fine-resolution terrain elevation data is critical to intelligence preparation of the battlefield (IPB), mission planning and rehearsal, battlefield visualization and precision targeting. Currently available digital terrain elevation data (DTED) Level I (90-meter resolution) and Level II (30-meter resolution) do not have sufficient resolution or accuracy to support current and future military requirements. HRTI with a resolution of one to three meters (HRTI Levels 4 & 5) and absolute geographic accuracy of 2-3 meters is required and will be provided by the IFSAR Mapping ACTD. The IFSAR Mapping ACTD will also provide fine-resolution synthetic aperture radar (SAR) imagery, and a change detection capability to meet future battlefield geospatial intelligence requirements. The use of IFSAR for topographic mapping provides all-weather day/night capabilities. Thus, cloud covered regions of the world, many of which have large information voids today, can be mapped with high-resolution terrain data and imagery.

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. Initiate Spiral III development phase of TEBO tools and CONOPS. Integrate EBO processes and tools into the USFK integrated mission architecture and standard operating procedures. An limited military utility assessment will focus on measuring the extent to which the concept has been adopted across the staff organizations and incorporated into their processes by measuring the effectiveness of the process and the tools provided to facilitate that process. Evaluations will focus on the enhanced understanding of an adversaries vulnerabilities and potential actions/reaction, while increasing the number of effects indicators tracked and analyzed. Continue CONOPS development. In FY06 and FY07, will participate in USFK and JFCOM exercises.

Leave integrated operational tools and processes supporting EBO in the USFK theater architecture.

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 JPSD is a element of the Program Executive Office, Intelligence, Electronic Warfare, and Sensors (PEO IEW&S), Fort Monmouth, NJ. Work is done at JPSD, Ft. Belvoir, VA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Joint Intelligence, Surveillance and Reconnaissance (JISR) ACTD - FY04: Refined and enhanced interoperability reviews of Defense Information Infrastructure/ Common Operating Environment (DII/COE) certification from appropriate certification authorities to include DISA. Transition Memoranda of Agreements have been accomplished with programs of records, ASAS-L, CHIMS, DCGS-A, Advanced Field Artillery Tactical Data Systems (AFATDS), AND C2PC. In the JISR 2.0 release, JISR will be platform independent, operating both on windows and unix. In September of FY05, JISR will be transitioned fully into Counter Intelligence/Human Intelligence Management Systems (CHIMS), Command Control Personal Computer (CZPC), and Distributed Data and Visualization and Mangement (DDVM). FY05: - Complete sustainment support to respective service and joint C4ISR user warfighters of the JISR product delivered in FY04. Supported technology transition to programs of record; ASAS-L, CHIMS, AFATDS, C2PC, GCCS, DCGS-A, MCS-L and JC2. Deployed an additional two servers in support of OIF II/OIF III expanding our user base to the coalition partners. Maintained and upgraded the current set of JISR servers in support of operations and transition. Completed the ACTD.	12205	7763	0	0
Interferometric Synthetic Aperture Radar (IFSAR) Mapping ACTD – FY05: Complete subassembly design, procurement, development integration and test for radome/antenna shroud, RF subsystem, transmitter, radar electronic assemblies 1 through 4, airborne and ground systems managers, and radar operator workstation. FY06: Complete system integration and test for all elements of Tactical IFSAR sensor Unit #1, including environmental testing. Deliver Unit #1 to Rancho Bernardo for integration testing into Predator-B and developmental flight testing.	0	2521	5727	0

Accomplishments/Planned Program A(continued)	FY 2004	FY 2005	FY 2006	FY 2007
Theater Effects Based Operations (TEBO) - FY06/07 – Initiate Spiral III development phase of TEBO tools and CONOPS. Integrate EBO processes and tools into the USFK integrated mission architecture and standard operating procedures. Will conduct a limited military utility assessment focusing on measuring the extent to which the concept has been adopted across the staff organizations and incorporated into their processes by measuring the effectiveness of the process and the tools provided to facilitate that process. Conduct evaluations focusing on the enhanced understanding of an adversaries vulnerabilities and potential actions/reaction, while increasing the number of effects indicators tracked and analyzed. Continue CONOPS development. Participate in USFK and JFCOM exercises.	0	0	6384	12529
Totals	12205	10284	12111	12529

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	10721	12441	12766
Current Budget (FY 2006/2007 PB)	10284	12111	12529
Total Adjustments	-437	-330	-237
Net of Program/Database Changes			
Congressional Program Reductions	-155		
Congressional Rescissions			
Congressional Increases			
Reprogrammings			
SBIR/STTR Transfer	-282		
Adjustments to Budget Years		-330	-237

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603270A - EW TECHNOLOGY**

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	26117	21357	16801	17940	18607	18642	19139	18522
K12	EW DEMONSTRATIONS (CA)	4282	8916	0	0	0	0	0	0
K15	ADVANCED COMM ECM DEMO	4715	2841	8184	9084	9342	9245	9322	9410
K16	NON-COMMO ECM TECH DEM	7390	6245	8617	8856	9265	9397	9817	9112
K19	MULTIPLE INTEL REMOTED SENSOR SYSTEM - BLK 1	4865	958	0	0	0	0	0	0
K20	SHORTSTOP	4865	2397	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This Program Element (PE) matures and demonstrates multi-intelligence remote sensor technologies and electronic warfare (EW) survivability 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. 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 US Army 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. This project also supports demonstrations of automatic/automated fusion of intelligence, information, and data from multiple sources to provide unit of action/unit of employment common operating picture (COP). 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 booby trap improvised explosive devices (IEDs). Survivability efforts in this PE are coordinated with PE 0603313 (Missile and Rocket Advanced Technology) and PE 0603003A (Aviation Advanced Technology). 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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	9382	17473	18504
Current Budget (FY 2006/2007 PB)	21357	16801	17940
Total Adjustments	11975	-672	-564
Net of Program/Database Changes			
Congressional Program Reductions	-313		
Congressional Rescissions			
Congressional Increases	12800		
Reprogrammings			
SBIR/STTR Transfer	-512		
Adjustments to Budget Years		-672	-564

Change Summary Explanation:

Six FY05 Congressional adds totaling $12800 were added to this PE.

FY05 Congressional Adds with no R-2A:
($1391) Aerial Canopy Sensor Delivery System (ACSDS) Project K12: The purpose of this one year congressional add is to develop a air deliverable remote monitoring system that supports enhanced intelligence gathering, information exfiltration in a jungle environment. No additional funding is required to complete this project.

($959) Ground Combat Vehicle Laser Warning, Project K12: The purpose of this one year Congressional add is for ground vehicle laser warning system demonstration for Future Combat Systems applications. No additional funding is required to complete this project.

($958) Multifunction Intelligence and Remote Sensor System Advanced Technology, Project K19: The purpose of this one year Congressional add is to mature power management techniques/algorithms for ground sensors and mature techniques for Low Probability of Intercept/Low Probability of Detection communications. No additional funding is required to complete this project.

($2877) Portable Level I Fusion Tool Set, Project K12: The purpose of this one year Congressional add is for development of a Measurement and Signature Intelligence tool kit supporting Improvised Explosive Devices and Rocket Propelled Grenade exploitation. No additional funding is required to complete this project.

($2398) Shortstop Electronic Protection System, Project K20: The purpose of this one year Congressional add is to demonstrate advanced countermeasure techniques for selected disruption and usage denial of sophisticated booby traps. No additional funding is required to complete this project.

($3692) US Army Tactical ELINT for Ground Maneuver Forces, Project K12: The purpose of this one year Congressional add is to mature the application of specific emitter identification techniques to evolving Army ELINT mission requirements by porting existing algorithms to hardware and field testing to verify performance. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603270A - EW TECHNOLOGY**	**K15**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
K15	ADVANCED COMM ECM DEMO	4715	2841	8184	9084	9342	9245	9322	9410

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. Electronic Support for the Future Force (ESFF) 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. Information Operations 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 2004	FY 2005	FY 2006	FY 2007
- Electronic Support for the Future Force (ESFF): This effort matures and demonstrates technologies that enable tactical signal intercept and jamming. In FY04, provided advanced simulation capability of Electronic Support Measure (ESM) sensors and integrated it into the Mounted Maneuver Battlespace Lab at Ft. Knox to evaluate tactics and tactical Internet throughput requirements to supporting networked, unattended radio frequency sensors for the Unit of Action (UA). In FY05, perform lab and field test of the networked radio frequency (RF) ESM sensor architecture for unmanned ground and air vehicle applications for the UA; integrate and demonstrate unattended ground and air RF ESM sensors with the network radio links matured by the Networked Sensors for the Future Force Advanced Technology Demonstration program and other UA efforts. In FY06, will test UAV and UGS ESM in a warfighter operational environment that demonstrates real time collection, ID and Location with sensor data fusion. In FY07, will test UAV and UGS as integrated Electronic Support (ES) system in high emitter density suburban and urban environments; will transition ESM to Tactical Signals Intelligence Payload and Future Combat Systems.	970	2500	4000	4500
- Information Operations: In FY05, identify and test techniques to cross cue/correlate geolocation and virtual address locations in a lab environment; refine techniques for signal detection, identification, location and isolation against representative targets and demonstrate a hardware suite capable of hosting these techniques. In FY06 will integrate initial set of techniques into hardware suite and test at the component level and assess performance against previously collected field data. In FY07, will mature existing techniques and integrate remaining techniques into objective hardware suite; will test as an end-to-end capability in the laboratory/chamber environment against representative targets, and conduct a demonstration of an integrated capability in an operationally relevant environment.	0	341	4184	4584
- Single Integrated Ground Picture (SIGP): SIGP is the ground component of the Joint Battle Management Command and Control (JBMC2) capability initiative providing enhanced Situational Awareness that enables precise and decisive command & control in the Battlespace. In FY04, researched what is being done to build, coordinate, and ensure joint and coalition data and information interoperability/availability across the Battlespace; baselined current warfighter capabilities to access, fuse, and filter information from multiple sources; performed operational and systems engineering analysis to identify information interoperability gaps; established Joint standards, architectures, and system requirements for Current/Future Force capabilities based on lessons learned, emerging Joint operational concepts (OPCONs) and concepts of operation (CONOPS).	3745	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Totals	4715	2841	8184	9084

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603270A - EW TECHNOLOGY**	**K16**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
K16	NON-COMMO ECM TECH DEM	7390	6245	8617	8856	9265	9397	9817	9112

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 signature management and 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 Future Combat Systems (FCS)/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 those Electronic Support (ES) technologies used against communications and non-communications signals for targeting 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 Unit of Action 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 2004	FY 2005	FY 2006	FY 2007
- Sensor Countermeasures for the Future Force: This effort matures and demonstrates an organic, multifunctional on the move force protection capability that will detect and neutralize enemy sensors, communications, and remotely controlled weapons data links, providing a level of survivability to dismounted, light and medium forces not currently available. In FY04, matured and demonstrated an Electronic Counter Measure (ECM) capable of neutralizing booby-traps; transitioned this capability to PM Electronic Countermeasures for immediate fielding to US troops. In FY05, mature ECM techniques, using receivers, antennas and jamming sources in a laboratory environment; refine ECM techniques and conduct field-testing of algorithms and radio frequency receivers against weapon control links to neutralize remote controlled weapons. In FY06, will demonstrate capability to detect, locate and jam enemy netted sensors; demonstrate countermeasures against multi-spectral sensor networks to include radio frequency (RF), electro-optical (EO), acoustic and magnetic sensors.	2990	1979	6617	0
- Integrated Countermeasures and Integrated Survivability: This effort matures and demonstrates technologies that enhance vehicle system survivability. In FY04, integrated and demonstrated an early version breadboard 160x160 array, two color (red and blue) uncooled mid-wave infrared (IR) ground vehicle missile-warning sensor system with detection/tracking algorithms; supported TARDEC's Integrated Army Active Protection System on-the-move demo; conducted initial tech assessment of Ultraviolet (UV) missile warning sensor for ground based application. In FY05, demonstrate added capability to missile warning sensors; mature hardware modules and software algorithms to enable UV and IR missile warning sensors to detect muzzle flash from small arms.	3200	2266	0	0
- Fusion Based Knowledge for the Future Force (FBKFF): In FY04, investigated requirements for an analyst-computer interface system based on cognitive task analyses done with Army Military Intelligence analysts. In FY05, identify requirements and develop a plan for integrating supporting software such as that for terrain reasoning and modeling and simulation with software being developed to retrieve data and to perform fusion. In FY06, will integrate software elements for answering commanders' intelligence requirements & conduct experiments. In FY07 will demonstrate additional data sources, supporting software, and applications into the system; will conduct experiments to evaluate fully integrated set of software assets to assess their utility in reducing the information overload of reports that analysts will need to analyze and interpret to provide adequately fast and high quality answers for the commander's priority intelligence requirements in the Future Force's UA.	500	2000	2000	3000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Tactical Wireless Network: In FY04, provided simulated intruder attacks to test Network Assurance mechanism being matured to protect mobile ad hoc wireless systems and networks; attempted to exploit weaknesses in mobile ad hoc wireless protocols and test Wireless Intrusion Detection efforts; performed laboratory and field-testing of security policy management software that receives security alerts from intrusion detection sensors and attempts to redefine network security policy to counteract.	700	0	0	0
- Common Air/Ground Electronic Combat Suite: This effort matures and demonstrates technologies to increase the survivability of air and ground platforms. A common set of warning sensors and electronic countermeasures will be demonstrated in an airborne as well as ground environment. In FY07, will mature a multiband, solid state laser for electronic countermeasure applications; will investigate small solid state radio frequency (RF) modules to jam anti-aircraft radar systems, top attack munitions, RF fuzed artillery, low probability of intercept radar systems and remotely detonated booby traps.	0	0	0	5856
Totals	7390	6245	8617	8856

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603313A - Missile and Rocket Advanced Technology

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		128221	115332	70066	42939	72272	85892	88010	92984
206	MISSILE SIMULATION	9682	10470	3190	3277	3440	3491	3521	3546
263	FUTURE MSL TECH INTEGR(FMTI)	43667	29956	39635	14277	20826	37780	45694	52181
550	COUNTER ACTIVE PROTECTION	6721	5080	11000	12237	15313	15316	8167	5614
655	HYPERVELOCITY MISSILE TD	54359	50887	9367	0	0	0	0	0
704	ADVANCED MISSILE DEMO	6009	5997	6874	2950	3394	0	0	0
G03	ARMY HYPERSONICS ADVANCED TECHNOLOGY	0	0	0	10198	29299	29305	30628	31643
NA6	MISSILE AND ROCKET INITIATIVES (CA)	7783	12942	0	0	0	0	0	0

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 Force and, where feasible, exploits opportunities to enhance Current Force capabilities. Efforts are conducted through system simulation, design, demonstration, and test in laboratory and operational scenarios. This PE includes demonstrations of advanced tactical missiles, real-time hardware-in-the-loop simulations, and aircraft and ground system survivability efforts. The technologies focused on in this PE enhance the warfighting capabilities of 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), Compact Kinetic Energy Missile (CKEM), Advanced Multi-Mission Precision Guided Munition (AMMPGM), Air Defense for the Future Combat Systems (FCS) Unit of Action (concentrating on defense against Rockets, Artillery and Mortars (RAM)), Close-In Active Protection System (CIAPS) for ground and air platforms, and development and demonstration of hypersonic missile technology. The Army Hypersonics Applied Research program matures and demonstrated expendable hypersonic missiles and will advance the national goals in hypersonic weapons maturation. Survivability efforts are coordinated with PE 0602303A (Missile Technology), PE 0603003A (Aviation Advanced Technology) and PE 0603270A (Electronic Warfare 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	92800	66669	51189
Current Budget (FY 2006/2007 PB)	115332	70066	42939
Total Adjustments	22532	3397	-8250
Net of Program/Database Changes			
Congressional Program Reductions	-1713		
Congressional Rescissions			
Congressional Increases	27500		
Reprogrammings			
SBIR/STTR Transfer	-3247		
Adjustments to Budget Years		3397	-8250

Change Summary Explanation:
FY07 - Funds realigned ($8250K) to higher priority requirements.

Eleven FY05 Congressional adds totaling $27500 were added to this PE.

FY05 Congressional adds with no R-2A:

($1151) Long Range Aviation Missile (LRAM), Project NA6: The purpose of this one year Congressional add is to fund research on long-range missile technology. No additional funds are required to complete this project.

($959) Micro-factories for Precision Parts Program, Project NA6: The purpose of this one year Congressional add is to develop a "desktop" factory using modular micro CNC machines. No additional funding is required to complete this project.

($863) Multi-Controlled UAV Plug-n-Play Sensor, Project NA6: The purpose of this one year Congressional add is to fund research on a plug-and-play sensor for UAVs. No additional funding is required to complete this project.

($1726) Persistent Protective Surveillance for the Survivability of Rotary Wing Aircraft, Project NA6: The purpose of this one year Congressional add is to fund research on persistent protective surveillance for the survivability of rotary wing aircraft. No additional funding is required to complete this project.

($959) Smart Energetics Architecture for Missile Systems, Project NA6: The purpose of this one year Congressional add is to fund research on a smart energetics architecture for missile systems. No additional funding is required to complete this project.

($959) Volumetrically Controlled Manufacturing (VCM), Project NA6: The purpose of this one year Congressional Add is to develop a precision synthetic manufacturing process that uses mathematical algorithm to precisely calculate 3D material matrix coefficients, in discrete volumes, and then replicates those properties within a manufacturing process. No additional funding is required to complete this project.

($4603) Warfighter Protection and Homeland Security Lab, Project NA6: The purpose of this one year Congressional add is to apply army simulation technology to force protection and homeland security. No additional funding is required to complete this project.

($1726) Waterside Wide Area Tactical Coverage and Homing (WaterWATCH), Project NA6: The purpose of this one year Congressional add is to fund research in the Waterside Wide Area Tactical Coverage and Homing (WaterWATCH) project. No additional funds are required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**206**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
206	MISSILE SIMULATION	9682	10470	3190	3277	3440	3491	3521	3546

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 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 reducing 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Missile Simulation - Missile Simulation – In FY04, continued the maturation of a tri-mode (RF MMW, semi-active laser, and IR) guidance HWIL capability and continued the maturation of a multi-channel Laser Detection and Ranging (LADAR) radar scene projector for use in HWIL simulation; matured end-to-end HWIL missile simulation techniques with remotely-located ground equipment (launchers, Command & Control, Communications, Computers and Intelligence (C4I) units, fire control sensors and units) connected to real-time HWIL missile components and simulations. In FY05, will complete the maturation of a tri-mode missile guidance HWIL simulation capability and demonstrate the performance of a multi-channel LADAR scene projector for HWIL simulation of LADAR sensors; and extend the capabilities of MMW HWIL simulation capabilities at 35 GHz by addressing synthetic aperture radar (SAR) types of missile guidance. In FY06, will apply the LADAR scene projector to mature closed-loop HWIL capabilities for NLOS-LS and other related acquisition programs; will initiate integrated digital electronic circuit techniques to improve MMW signal generation; will extend capabilities for semi-active laser HWIL simulation using updated lasers and detailed laser illuminator scene modeling. In FY07, will complete the application of the LADAR scene projector and integrate it with an advanced passive IR scene projector with low-temperature background scene capability; will continue the development of HWIL simulation techniques for missiles guided by MMW synthetic aperture radar signals; will continue work digital circuit techniques for application in MMW signal generation.	2966	3087	3190	3277
Missile Simulation Technology – In FY04, this Congressional add expanded the missile simulation capability to included representations of fielded missile systems. It also included representatives of missiles expected to be in the Unit of Action; also initiated the Joint Aviation, Missile, and Unmanned Systems (JAMUS) simulation to conduct engineering analyses on topics in a Future Force context; commenced the maturation, implementation, integration and test of missile simulation capabilities in the Modeling Architecture for Technology and Research Experimentation (MATREX) environment. MATREX is envisioned to support distributed simulations of various current, Future Combat Systems (FCS), and Future Force evaluations, technology trade studies, and experimentations. This effort will facilitate the modeling and simulation capabilities of various Army agencies allowing cooperative simulation efforts such as the MATREX. In FY05, will continue maturation of the JAMUS and MATREX systems to gain confidence in their capabilities and to initiate simulation validation exercises across a range of varied scenarios. No additional funding is required.	6716	7383	0	0
Totals	9682	10470	3190	3277

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**263**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
263	FUTURE MSL TECH INTEGR(FMTI)	43667	29956	39635	14277	20826	37780	45694	52181

A. Mission Description and Budget Item Justification: This project demonstrates advanced tactical missile technologies including seekers, propulsion, airframes, communications, and guidance and controls for the Non-Line-Of-Sight Launch System (NLOS-LS) Technology program supporting Future Combat Systems (FCS) and the Future Force. These technologies include the demonstration and integration of networked missile radios and missile antennas; multi-mode seeker concepts, controllable thrust motors (gels, pintle-controlled solids, or air breathing), aided target acquisition (ATA). The Army's baseline communications networking waveform for the NLOS-LS missiles was matured and demonstrated in conjunction with the Communications Electronics Research Development Engineering Center (CERDEC) Soldier-Level Integrated Communications Environment (SLICE) program. In addition, the project matured two missile radio designs capable of hosting the SLICE waveform as risk mitigation missile radio and antenna that supports current NLOS-LS System Development and Demonstration (SDD) program. Testing of the NLOS-LS products from both the SLICE and risk mitigation efforts are funded and accomplished by this program. Secure wide-band data link hardware, allowing target position updates during missile flight, and transmission of imagery to the ground were demonstrated. Seeker technology will address imaging infrared, Laser Detection and Ranging (LADAR), and millimeter wave seeker technologies, combined with semi-active laser technology, to provide precision strike and fire-and-forget guidance modes. Affordable, controllable thrust rocket motors, such as gelled bi-propellants or pintle-controlled solids, will be demonstrated to provide longer ranges and shorter flight times while increasing system insensitivity and robustness in air-to-ground, ground-to-ground, and ground-to-air roles. A missile communications network enables 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. These efforts provide support for the NLOS-LS SDD and are supported by the Program Executive Officer Tactical Missiles. In future years, a technology demonstration of air defense capability for the unit of action, concentrating on defense against rockets, artillery, and mortars will be performed using technologies funded under PE 0602303A. In addition, smaller, lighter weight, and more affordable missile technologies will be demonstrated using the technology matured under PE 0602303A. 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
NLOS-LS Communications Simulation: In FY04, evaluated results of simulation experiments to refine communications requirements for NLOS-LS; updated communications simulation with vendor enhancements and re-evaluated NLOS-LS communications performance in an operational environment.	2406	0	0	0
NLOS-LS Waveform Development: In FY04, matured JTRS SCA 2.2 compliant waveform and networking protocols for NLOS-LS; completed software maturation of the baseline NLOS-LS waveform (Soldier Radio Waveform, version 1) and the risk mitigation waveform (Missile Network Waveform) and conducted rigorous laboratory testing of the waveform software to prepare for captive-carry testing in a 20-node communications networking test.	9223	0	0	0
NLOS-LS Missile Radio and Antenna: In FY04, matured risk mitigation missile radio & antenna for NLOS-LS; fabricated and assembled 40 missile-form-factored JTRS prototype radios and antennas from each of two vendors and performed rigorous testing in the laboratory in preparation for captive-carry testing.	8780	0	0	0
NLOS-LS Communications Testing: In FY04, planned and conducted a realistic, real world test of the radio hardware, antennas, and waveforms; conducted pre-tests to give the two competing contractors a chance to dry-run their communication networking solutions, and successfully performed the culminating captive-carry tests using aircraft and SUVs as surrogate missiles and C2 nodes in a 20-node test of both the Soldier Radio Waveform and the Missile Network Waveform; tested 10 aircraft-based radios and 10 mobile ground-based radios operating in a variety of terrain and altitudes while in motion and replicated NLOS-LS in an operational environment.	4330	0	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Enhanced Seeker Development - In FY04, redesigned uncooled infrared (UCIR) optics for increased Field of View (FOV) for the enhanced Precision Attack Missile (PAM) seeker maturation effort, improved Aided Target Acquisition (ATA), fabricated and assembled two prototype seekers and performed bench testing, tower testing and captive flight testing and data reduction. Generated ATA analysis and assessment tools (software/simulation development) for ATA performance evaluations. In FY05, will complete maturation of enhanced UCIR seeker; bench and captive flight tests; conduct environmental/performance evaluation testing and transition to the enhanced UCIR seeker supporting NLOS-LS SDD. In support of spiral development, mature multiple seeker technologies for NLOS-LS; perform enhanced semi-active laser (SAL)/LADAR trade studies, component maturation and bench testing, and develop conceptual system designs; evaluate tri-mode (infrared/milli-meter wave/semi-active laser) seeker technology applications to NLOS-LS and mature/adapt seeker designs for integration; perform ATA performance evaluations; and prepare PAM and LAM sensors for NLOS-LS system testing. In FY06, will perform enhanced semi-active laser (SAL)/LADAR system maturation and begin fabrication and component testing; perform tri-mode seeker system maturation and begin fabrication and component/subsystem testing; begin captive flight testing of both the PAM seeker (Tri-mode PAM) and LAM seeker (Enhanced LADAR); will conduct realistic system testing of PAM and LAM sensors in relevant environment; and will perform ATA performance evaluations. In FY07, will evaluate and mature technology transition/future enhancements for seeker maturation; continue system maturation, fabrication and subsystem/system testing in relevant environments (captive flight testing) of SAL/LADAR technology for spiral transition to NLOS-LS; and will continue tri-mode seeker system maturation, fabrication, and subsystem/system testing.	8071	16760	21830	6577

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Advanced Propulsion – In FY04, conducted static tests of a 7-inch diameter, minimum signature propellant, pulse missile motor; performed nozzle material investigations and static tested with PAM type propellants. In FY05, identifies and evaluates critical technology for an enhanced solid propellant pintle; designs, matures, and fabricates critical PAM propulsion subsystems and perform laboratory subsystem/system level testing, begins system trade studies and maturation of a high efficiency turbofan engine leveraging from Loiter Attack Missile - Aviation (LAM-A) propulsion technology advancements. In FY06, will continue the design, maturation, and fabrication of critical PAM propulsion subsystems (composite case, igniter, nozzle/pintle/actuator, propellant grain) and perform laboratory/relevant environment system level testing; will conduct static tests of flight weight prototype systems (ambient/cold/hot) and perform insensitive munition screening tests; will mature and demonstrate a high efficiency turbofan engine and conduct rig testing of critical hardware. In FY07, will continue the design, maturation, and fabrication of critical PAM propulsion subsystems for spiral insertion and perform laboratory/relevant environment subsystem/system level testing; will fabricate and integrate flight worthy prototype subsystems and prepare for controlled test flight; will mature and demonstrate a high efficiency turbofan engine, conduct baseline evaluations and testing of critical hardware and demonstrate prototype engine hardware.	2180	3821	5925	3500
Warhead Testing and Integration - In FY04, performed lethality testing and integration of novel warhead designs for NLOS-LS application. In FY05, matures advanced, lighter, unitary/multi-purpose warhead technologies and integrates these technologies for increased lethality against anti-armor and other target sets/environments including non-lethal effects; exploits various fragmentation and shape charge technologies and optimize for NLOS-LS; matures explosive fill technologies including thermobarics; matures lethality toolset/models for warhead lethality assessments. In FY06, will mature advanced, lighter, unitary/multi-purpose combined effects warhead technologies for potential spiral insertion into NLOS-LS; will fabricate, integrate and static/dynamic test critical technologies (fragmentation, shape charge, and explosive fill); will perform verification/validation of toolset/models. In FY07, will continue maturation of warhead technologies and integration for increased lethality against anti-armor and other target sets/environments including non-lethal effects for spiral insertion into NLOS-LS. Will perform integrated warhead static and dynamic tests and validate modeling and simulation tools with test results.	2501	3126	3960	1400

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Modeling /Simulation and System Performance Evaluation – In FY04, conducted system analysis and simulation for initial few-on-few capabilities; matured Common Simulation Framework (CSF) 3-Degrees-Of-Freedom simulation for rapid trade studies, and enhanced visualization demonstrations; completed baseline affordability/cost analysis/ and manufacturing analysis of seekers, warhead and propulsion system technologies. In FY05, establishes an initial integrated flight simulation (IFS) capability, develops capability of few-on-few full-system, simulation and performs trade studies, identifying alternate variants and critical subsystem requirements to achieve NLOS-LS Objective System performance; addresses manufacturing and affordability issues; performs component and system level testing for performance evaluations. In FY06, will increase fidelity of CSF-based and few-on-few simulations; will perform trade studies, identifying alternate variants and critical subsystem requirements to achieve NLOS-LS Objective System performance; will address manufacturing and affordability issues through system research, design and maturation. In FY07, will conduct preflight and post flight reconstruction of flight tests performed; will support simulation formal accreditation process. Will continue trade studies taking into account various regions, targets, environments and countermeasures, identifying alternate variants and critical subsystem requirements to achieve NLOS-LS Objective System performance; will address manufacturing and affordability issues; will conduct excursions to expand the envelope of conditions evaluated by the simulation.	2806	6249	7920	2800
Loiter Attack Munition-Aviation (LAM-A) – This one year Congressional add generated force-on-force simulation exercises with warfighters, performed hardware-in-the-loop simulations with flight hardware, completed system vulnerability and turbofan propulsion studies, continued the aircraft cockpit integration design, tests breadboard high-bandwidth data-link hardware; and prepared for control vehicle test flights of a long-range, precision-strike weapon for the aviation forces. No additional funding is required to complete this project.	3370	0	0	0
Totals	43667	29956	39635	14277

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**550**

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
550 COUNTER ACTIVE PROTECTION	6721	5080	11000	12237	15313	15316	8167	5614

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 RPGs and small arms. Close-In Active Protection Systems (CIAPS) Phase 1 prototype has been demonstrated on a light armored vehicle. New sensor and interceptor technologies are being 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 to 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 opportunity for operator input to survivability system configuration and guiding all aspects of technology maturation. Systems approach will ensure that we avoid interference among survivability system components and techniques while taking every advantage for synergy and assistance from existing aircraft survivability components to improve the performance of the entire survivability suite. This project complements work done on adaptive IR suppressor, Manned Unmanned Rotorcraft Enhanced Survivability (MURES), Survivability Planner Associate Re-router (SPAR) acoustic signature technologies matured in the Aviation Advanced Technology (PE 63003/313). This effort is building on the expertise developed in support of rockets, missile, sensors, 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- Close-In Active Protection Systems (CIAPS) - In FY04, this completed Phase I demonstration with additional on-the-move testing and clutter testing associated with the transition of CIAPs technology to PM-Stryker. In FY06, will demonstrate a prototype CIAPS and technology matured under PE 0602303A missile technology, mounted on a HMMWV that defeats RPGs fired from short range with multiple threats; will conduct live range testing of system while stationary and on-the-move.	3730	0	5000	0
- Close-In Active Protection Systems (CIAPS) Congressional Add - In FY04, this Congressional add completed Phase 1 demonstration of CIAPS prototype on light armored vehicle (LAV). Completed tradeoff analysis for CIAPS concept for tactical wheeled vehicles. In FY05, this Congresional add will complete fabrication of science and technology prototype radar sensor.	2692	5080	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Integrated Aircraft Survivability Technology - In FY06 will evaluate, analyze, and initiate development of system solutions applying active protection techniques for aircraft survivability in defeat of RPGs and other non-traditional threat weapons. Will incorporate small arms/RPG indication and warning, automated threat avoidance, and active defeat concepts for aircraft. FY07 will demonstrate initial system breadboard implementations of integrated system solutions providing aircraft survivability against the full spectrum of threats.	0	0	6000	12237
- Small Arms ID Overwatch - In FY04, completed ground tests of eight passive eletro-optic sensors from elevated positions to evaluate ability to detect and locate small arms fire.	299	0	0	0
Totals	6721	5080	11000	12237

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**655**

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
655 HYPERVELOCITY MISSILE TD	54359	50887	9367	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program matures and demonstrated hypervelocity missile technology that will enable the Future Force by providing overwhelming lethality with a small, light, fast hypervelocity compact kinetic energy missile. The goal of the Compact Kinetic Energy Missisle (CKEM) ATD is to demonstrate enhanced system lethality with a threshold of 60-inch long, 100-lb missile and an objective of 54-inch long, 65-lb missile. Miniature guidance inertial measurement unit (IMU) technology will be demonstrated to survive high-g missile launch and will provide precision guidance to kill targets at ranges of 0.4-5 kilometer. The program will mature and demonstrate advanced component and subsystem and system level technologies in a missile system configuration to achieve next-generation system level performance improvements. 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Compact Kinetic Energy Missile (CKEM) - In FY04, demonstrated critical hypervelocity missile component technologies in an integrated missile design; performed critical technology demonstrations and subsystem integration testing and evaluation including system simulations to validate performance models, conducted full-scale lethality sled tests against advanced threat armors to evaluate penetrator design performance; integrated advanced propulsion designs into competing missile configurations and conducted two Controlled Flight Tests of competing missile prototype designs; and performed the Preliminary Design Reviews (PDR) of ATD missile design. In FY05, provides a detailed design that is traceable to a tactical system; fabricates the missile, and integrates it with a surrogate weapon system for demonstration; will conduct testing in a Hardware-in-the-Loop (HWIL) facility and independently evaluates a system simulation of the design to verify performance for the Critical Design Review (CDR); conducts two controlled flight tests of the CKEM missile design. In FY06, will continue the CKEM ATD with the guided flight tests conducted from a vehicle representative of an FCS vehicle and a launcher with a representative/surrogate fire control. At least two of the guided flight tests will be against an instrumented vehicle representative of the armor threat.	54359	50887	9367	0
Totals	54359	50887	9367	0

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**704**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
704	ADVANCED MISSILE DEMO	6009	5997	6874	2950	3394	0	0	0

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 Future Combat Systems (FCS) and 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 the FCS family of 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 & 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
- FC-NET - - In FY04, designed and matured technical fire control components through modeling and simulation; completed integration of the multi-weapon technical fire control architecture into the lethality module of the Crew integration and Automation Test Bed (CAT) Advanced Technology Demonstration (ATD); demonstrated common technical fire control architecture in a manned ground vehicle and an unmanned armed ground vehicle in a virtual test environment; continued to mature the Weapon-Target Pairing Algorithms currently identified as a for FCS. In FY05, develop a technical fire control interface to the tactical fire control infrastructure and finalize the Weapon-Target Pairing Algorithms; demonstrate and test in a virtual simulation environment a distributed Technical Fire Control Architecture. In FY06, finalize the technical fire control and demonstrate in a live exercise.	4896	3400	3900	0
- Advanced Multi-Mission Precision Guided Munition (AMMPGM) - In FY04, completed a preliminary design of the warhead and fuze. In FY05, complete static and dynamic warhead testing and limited qualification testing, including insensitive munition testing. In FY06, will mature a common joint Army/Navy smart 2.75 inch launcher; and design strapdown uncooled Infrared (IR) imaging seeker technology for a fire-and-forget capability for 2.75 inch missiles. In FY07, will build a prototype launcher and demonstrate it through platform integration and live fire testing. Will build a prototype strapdown uncooled IR seeker and perform a static test.	1113	2597	2974	2950
Totals	6009	5997	6874	2950

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603313A - Missile and Rocket Advanced Technology**	**G03**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
G03	ARMY HYPERSONICS ADVANCED TECHNOLOGY	0	0	0	10198	29299	29305	30628	31643

A. Mission Description and Budget Item Justification: This project funds advanced technology development to mature and validate, through experimental testing, the critical technologies required to develop expendable hypersonic missiles. Primary focus areas are those deemed critical for hypersonic weapon maturation to enhance Army operational capability in air and missile defense missions. These focus areas include scramjet engine components, active and passive thermal management systems, material selection and evaluation, airframe and engine component structural analysis and missile subcomponent design and development. Efforts will include experimental model design and fabrication, instrumentation of experimental models, extensive ground testing efforts of matured component technology and will build on preceding missile and engine component design efforts and will focus on further development, integration and validation through ground test activities at duplicated operational conditions. 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 Aviation & Missile Research, Development, and Engineering Center, Redstone Arsenal, AL.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Detailed Hypersonic Engine and Missile Component Design: In FY07, will transition of technology from PE 0602303A G02 to complete component technology maturation; begin integration of matured scramjet engine component designs; validate design concepts for inlets, combustor, fuel injectors, fuel mixing enhancement, thermal protection systems and other missile component technologies that were selected and evaluated in concept development phase of program in ground test facilities at duplicated flight conditions.	0	0	0	10198
Totals	0	0	0	10198

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	28995	33621	25327	29534	33095	36623	36682	37401
608	COUNTERMINE & BAR DEV	20754	21790	22042	25590	28675	31823	31787	32409
64C	COUNTERMINE DEMONSTRATIONS (CA)	5351	9012	0	0	0	0	0	0
683	ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES	2890	2819	3285	3944	4420	4800	4895	4992

A. Mission Description and Budget Item Justification: This program element (PE) matures and demonstrates the sensor technologies required to detect mines, minefields, improvised explosive devices (IEDs) and obstacles to enable assured mobility for the high operational tempo (OPTEMPO) of Future Combat Systems (FCS), Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. Project 608 focuses on concepts and technologies that will enable in-stride detection and breaching, close-in detection, area clearance, and neutralization of landmines. This project demonstrates the remote detection of minefields as well as individual landmine detection from handheld, ground, and aerial sensor systems; evaluates detection of both conventional and command detonated types of landmines (including IEDs), metallic and low/non-metallic; 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 landmine detection at very low false alarm rates. Efforts within this project assess airborne mine detectors for contingency applications and mature lightweight plug-and-play detectors for use in mission specific applications. Project 64C funds Congressional special interest items. Project 683 explores alternative systems for anti-personnel landmines and innovative concepts for minefield clearance. This PE will conduct modeling and simulation activities to assess the effectiveness of system concepts.

Work in this PE is related to and is fully coordinated with PE 0602712A (Countermine Systems), PE 0603710 (Night Vision Advanced Technology), and the 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 program adheres to Tri-Service/Project Reliance Agreements on conventional air/surface weapons and ground vehicles. 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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	25577	26696	27731
Current Budget (FY 2006/2007 PB)	33621	25327	29534
Total Adjustments	8044	-1369	1803
Net of Program/Database Changes			
Congressional Program Reductions	-549		
Congressional Rescissions			
Congressional Increases	9400		
Reprogrammings			
SBIR/STTR Transfer	-807		
Adjustments to Budget Years		-1369	1803

Change Summary Explanation:

Five FY05 Congressional adds totaling $9400 were added to this PE.

($1342) EDIT Advanced Landmine Detection, Project 64C: The purpose of this one year Congressional add is to mature a handheld time-domain electro-magnetic sensor and imaging detector based on a Resonant Microstrip Patch Antenna technology. No additional funding is required to complete this project.

($2877) Forward Looking Synthetic Aperture Stepped-Frequency Ground Penetrating RADAR (FLGPSAR), Project 64C: The purpose of this one year Congressional add is to demonstrate a prototype vehicle mounted forward looking ground penetrating radar for the detection of mines in roads and investigate use of same technology for detection on explosive devices along road sides. No additional funding is required to complete this project.

($1439) Landmine Detection System using Terahertz Radiation, Project 64C: The purpose of this one year Congressional add is to mature the THz database for landmine detection, and mature detectors/recorders for operator evaluation. No additional funding is required to complete this project.

($2398) Lightweight Rapidly Deployable Hardened Shelters, Project 64C: The purpose of this one year Congressional add is to develop lightweight, rapidly deployable hardened shelters. No additional funding is required to complete this project.

($959) SCANJACK Mine Clearing System, Project 64C: The purpose of this one year Congressional add is to demonstrate a mine clearing vehicle equipped with a double flail system designed to destroy landmines to a depth of 30cm in a variety of terrain conditions. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**	**608**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
608	COUNTERMINE & BAR DEV	20754	21790	22042	25590	28675	31823	31787	32409

A. Mission Description and Budget Item Justification: This project matures countermine technologies for integration into future Army systems to enable assured mobility of Future Combat Systems (FCS), Future Force, and where feasible, exploit opportunities to enhance Current Force capabilities. Specific activities include remote detection of minefields by aerial sensor systems and individual landmine detection by handheld and vehicle-based sensor systems and neutralization of individual mines and minefields. The landmines being addressed include conventional and command detonated, including improvised explosive devices (IEDs), metallic and low/non-metallic construction anti-tank and anti-personnel mines. This project will evaluate the potential for wide-area multi-sensor fusion detection systems, coupled with slower small-area confirmation sensors, to yield a high probability of mine detection (Pd) at very low false alarm rates (FAR). This project will evaluate airborne multispectral mine detection sensors and mature them for lightweight plug-and-play use on unmanned aerial vehicles (UAVs) in mission specific applications. The goal is for robust approaches to finding surface-laid and buried mines in temporally and spatially varying vegetation, soil, weather, and diurnal conditions. This project has the potential to provide advanced countermine capabilities to the mounted and dismounted soldier by adapting commercial or emerging technologies for standoff mine detection and neutralization. Detection technologies include, but are not limited to, wide band radar, acoustic, laser, explosive detection sensors, infrared and visual imagery, and radio frequency. Neutralization technologies include chemical reactants, electromagnetic energy, and kinetic energy. The intent is to provide increased operational tempo and survivability for U.S. Forces prior to their entry into harm's way. Efforts are supported by modeling and simulation assessments and defines potential system effectiveness. The FCS Standoff Mine Detection System effort will provide standoff mine/IED detection capability for faster rate of advance (ROA) in high threat areas, using sensors on both a ground vehicle and a UAV. The Autonomous Mine Detection Sensors effort will provide the ability to detect anti-personnel mines at faster ROA while removing the soldier from danger. The Ground Penetrating Radar Countermine On The Move effort will provide faster ROA for on-route detection and provide off-route detection capability with high Pd and low FAR. The Mine Neutralization for Assured Mobility effort will provide the warfighter with standoff area mine neutralization capability to enable in-stride breach for Unit of Action maneuver. The Joint Area Clearance ACTD transitioned several novel mine clearance technologies to PM-CCS and the Marine Corps. The Airborne IED/Mine Detection effort will demonstrate automated processes and algorithms that improve upon the change detection process that detects mines and IEDs. The Aerial Buried Minefield Detection effort will develop sensors and algorithms for detection of mines that have been buried for a long time. The False Alarm Reduction for Improved Optempo effort developed the Ground Penetrating Radar for robust detection of buried on-route mines.

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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
FCS Standoff Mine Detection System. In FY04, completed objective sensor design and demonstrated in a temperate environment. In FY05, demonstrate in an arid environment and transition organic aerial vehicle (OAV) component to Program Manager Close Combat Systems (PM CCS); establish baseline performance of bolt-on forward looking ground vehicle sensor and fusion aided target recognition (AiTR); improve fusion AiTRs; and link airborne sensors with ground vehicle suite to demonstrate performance of the combined mine detection approach. In FY06, will complete integration and fusion of forward looking sensors on a single platform; test and demo integrated ground vehicle sensor package and ATR. In FY07, will integrate OAV sensor link with vehicle mounted forward looking sensors; demonstrate integrated concept of OAV multiband IR sensors coupled with forward looking vehicle mounted sensor suite on host vehicle.	5700	5493	4990	4943
Autonomous Mine Detection Sensors (AMDS). In FY04, delivered surrogate small unmanned ground vehicle (SUGV) platform to hardware developers; completed initial phenomenology study for breadboard sensor design for use against anti-personnel mines; baselined sensor performance in field environment. In FY05, complete sensor and Automated Target Recognition (ATR)/signal processing studies; demonstrate brassboard sensors and initial ATR/signal processing approach on surrogate platform. In FY06, will commence integrating sensor prototypes and signal processing/ATR on SUGV platform; test sensor package on blind test lanes. In FY07, will complete prototype sensor build and ATR/signal processing implementation on SUGV platform and conduct tests in relative environments; prepare for transition to PM-CCS.	4704	4966	4954	2917
Ground Penetrating Radar (GPR) Countermine On The Move. In FY05, continue maturation of a faster wideband GPR integrated on a surrogate UGV for use against anti-tank mines; increase antenna scan and data acquisition rates for on-route detection, and improve the advanced Automated Target Recognition (ATR) algorithms for improved clutter rejection and tracking of rough terrain; begin mobility evaluation via a series of data collections with the improved GPR on rough terrain and analysis to determine potential capability for off-route detection. In FY06, will refine GPR hardware and ATR improvements and continue on and off route mobility evaluation. In FY07, will complete ATR development and GPR integration; will conduct a series of on and off route demonstrations in a variety of operational scenarios and under representative environmental conditions; will complete mobility evaluation.	0	4057	4413	5000

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Mine Neutralization for Assured Mobility. In FY05, conduct industry trade studies of neutralizer darts compatible with Army's guided multiple launch rocket system that will breach minefields from 5-30 km standoff; downselect to one approach and test against mines in Army soil environments and develop a comprehensive model; leverage Navy efforts in modeling and neutralizer dart testing. In FY06, will conduct inert dart flight tests of selected approach to verify feasibility; will conduct Army program review for approval to continue. In FY07, will conduct live dart flight test in anticipation of FY08 final demo; perform test analysis to define trades between cleared lane performance, mission parameters, and area effects.	0	2292	2627	5493
Joint Area Clearance (JAC) ACTD. In FY04, transitioned mine clearance technologies found to have military utility to Program Manager Close Combat Systems and Marine Corps Systems Command.	500	0	0	0
Airborne IED/Mine Detection. In FY05, develop automation algorithms for the change detection workstation (CDWS), developed under the Joint Area Clearance (JAC) ACTD, and evaluate multiple platform and emerging sensors options. In FY06, will continue algorithm development and integrate into the CDWS, and procure/integrate emerging sensors and aircraft imagery for an improved IED/mine detection capability. In FY07, will complete algorithm development and sensor integration, conduct flight tests, system demonstrations, and transition to Project Manager, Close Combat Systems (PM-CCS).	0	4982	5058	3924
Aerial Buried Minefield Detection. In FY07, will begin development of prototype(s) for detection of longer-term buried (greater than 3 days) anti-tank minefields from airborne platforms; use results from 6.2 phenomenology studies, sensor evaluations, and algorithm development to guide selection of prototype configurations and platform options. Sensor technology options include ultra-wideband ground penetrating radar and hyperspectral electro-optical or infrared imaging.	0	0	0	3313
Mine Detection False Alarm Reduction for Improved OPTEMPO. In FY04, matured and evaluated sensor mine detection technologies, ATRs, and signal processing techniques associated with each technology to improve robustness; integrated the most promising combination scanning/confirmation capabilities on a surrogate reconnaissance vehicle to demonstrate overpass capability and false alarm reduction performance.	9850	0	0	0
Totals	20754	21790	22042	25590

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**	**683**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
683	ANTI-PERSONNEL LANDMINE (APL) ALTERNATIVES	2890	2819	3285	3944	4420	4800	4895	4992

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 will include distributed anti-personnel surveillance systems (autonomous seismic, acoustic, and day/night imaging sensor systems), 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 will use simulation to evaluate new concepts and modify doctrine. This project will also construct and evaluate components and system architectures 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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603606A - Landmine Warfare and Barrier Advanced Technology**	**683**

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Anti-Personnel Landmine Alternatives. In FY04, began a study for the concept on networked personnel detection nodes, and completed modeling and simulation capabilities relevant to area denial. In FY05, collect imager data, begin radio and network capacity studies, begin modeling study of standoff detection, complete the concept study, and begin fabrication of a personnel detection and discrimination (combatant vs. noncombatant) networked testbed for demonstration in a relevant environment. In FY06, will complete standoff detection study, complete testbed and demonstrate initial personnel detection and discrimination capability. In FY07, will complete radio and network capacity studies, and continue algorithm enhancements to the personnel discrimination system and improve employment options for the system.	2890	2819	3285	3944
Totals	2890	2819	3285	3944

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603607A - JOINT SERVICE SMALL ARMS PROGRAM**	**627**

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
627 JT SVC SA PROG (JSSAP)	9335	9675	6581	6942	7263	7371	7435	7490

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 Future Combat Systems (FCS), the Future Force and, where feasible, exploits opportunities to enhance Current Force capabilities. The main effort is the Lightweight Machine Gun and Ammunition (LMGA). The LMGA, complementing both the Objective Individual Combat Weapon(OICW) and Objective Crew-Served Weapon(OCSW), will offer significantly reduced weight over the currently fielded M249 Machine Gun and its associated ammunition. This weapon 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, USMC PM Infantry Weapons; and PEO Special Programs, U.S. Special Operations Command (SOCOM).

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
OICW System Enhancement: In FY04, performed Micro Electrical Mechanical Systems (MEMS) based Safe & Arm (S&A) and fuze integration and fuze/warhead performance and safety tests; continued OICW 20mm system integration; conducted test firing of MEMS S&A in test barrel and demonstrated S&A in the Phase IV weapon; performed production cost study.	4256	0	0	0

Accomplishments/Planned Program A(continued)	FY 2004	FY 2005	FY 2006	FY 2007
Lightweight Machine Gun and Ammunition (LMGA): In FY04, performed system level trade studies to select concepts for a lightweight, reliable machine gun and ammunition. In FY05, conduct initial integration testing with Future Force Warrior (FFW) Lead Technology Integrator; build weapon and ammunition subsystems, perform preliminary integration and functionality testing to assess weapon operation and ammunition lethality and establish reliability baseline; use virtual prototyping (dynamic models) to advance the design and analysis of system level trade offs. In FY06, will build integrated weapon prototypes to test weapon and ammunition functionality and human factors and validate/update virtual prototypes; will adjust weapon system to incorporate improvements, mature weapon system to increase reliability; will modify ammunition as necessary to attain required lethality; assess maintenance and training issues and make modifications as necessary. In FY07, will perform final integration testing to demonstrate lethality and reliability of the lightweight weapons and ammo; will conduct user demonstration to update and complete human factors, maintenance, and training assessment, providing necessary data for Milestone B decision.	1710	5735	6581	6942
Anti-material Sniper Rifle (AMSR): This one year Congressional add evaluated weapon technologies in the areas of light weight materials, recoil mitigation and energy recovery, and demonstrated these in 25mm Anti-Material Sniper Rifle technology based on the XM107 .50 caliber Sniper Rifle. No additional funding is required to complete this effort.	3369	0	0	0
Advanced Demining Technology: This one year Congressional add is for maturation of an integrated, remote controlled mine detection and neutralization system. No additional funding is required to complete this project.	0	3940	0	0
Totals	9335	9675	6581	6942

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603607A - JOINT SERVICE SMALL ARMS PROGRAM**	**627**

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	5968	6844	7160
Current Budget (FY 2006/2007 PB)	9675	6581	6942
Total Adjustments	3707	-263	-218
Net of Program/Database Changes			
Congressional Program Reductions	-141		
Congressional Rescissions			
Congressional Increases	4100		
Reprogrammings			
SBIR/STTR Transfer	-252		
Adjustments to Budget Years		-263	-218

Change Summary Explanation:

One FY05 Congressional add totaling $4100 was added to this PE in Project 627; Advanced Demining Technology.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603710A - NIGHT VISION ADVANCED TECHNOLOGY

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	82687	102047	51761	49341	42638	43097	49173	49622
590	OVERWATCH ACTD	1791	5542	1350	492	0	0	0	0
C65	DC65	9043	5703	6174	4500	3360	3434	3502	3572
K70	NIGHT VISION ADV TECH	26905	19185	22521	23464	27511	27354	29290	29550
K73	NIGHT VISION SENSOR DEMONSTRATIONS (CA)	37020	54020	0	0	0	0	0	0
K86	NIGHT VISION, ABN SYS	7928	17597	21716	20885	11767	12309	16381	16500

A. Mission Description and Budget Item Justification: This Program Element (PE) matures and demonstrates critical 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 capabilities to acquire, engage, and destroy targets at longer ranges in complex environments and conditions (e.g. day/night, obscured, smoke, adverse weather) in support of Future Combat Systems (FCS), 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 a system of networked, low-cost, distributed unmanned sensors for battlefield situational awareness, and a cost effective targeting system (CETS) for autonomous target acquisition; demonstrate situational awareness for FCS 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 new lightweight very low-cost unattended ground sensors that will provide increased situational awareness and force protection capabilities for the FCS and future soldier systems; 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 for the Unit of Action (UA); demonstrate the combat overmatch benefits of 3rd Gen IR technology, including benefits such as rapid wide area search, Multi-Spectral 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 Horizontal Technology Integration (HTI) 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 3rd Gen IR assembly into an FCS ground based long range sensor suite; demonstrate components to improve soldier situational awareness. Project K73 funds Congressional special interest items. Project K86 funds efforts related to airborne night vision systems. This project demonstrates sensors and algorithms designed to detect mines and targets in camouflage, concealment and deception; demonstrate sensors for organic unmanned aerial vehicles for beyond-line-of-sight targeting in areas shadowed by terrain features; demonstrate imaging,

non-imaging, and active imaging sensors for Class II 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/crewmenbers independently for enhanced crew/aircaraft oeprations in day/night/adverse weather conditions.

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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, Virginia and the Army Space and Missile Defense Command, Huntsville, Alabama (the Overwatch ACTD).

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	50071	60779	60493
Current Budget (FY 2006/2007 PB)	102047	51761	49341
Total Adjustments	51976	-9018	-11152
Net of Program/Database Changes			
Congressional Program Reductions	-1604		
Congressional Rescissions			
Congressional Increases	56350		
Reprogrammings			
SBIR/STTR Transfer	-2770		
Adjustments to Budget Years		-9018	-11152

Change Summary Explanation:
FY06 - Funds realigned ($9018K) to higher priority requirements.

FY07 - Funds realigned ($11152K) to higher priority requirements.

Sixteen FY05 Congressional adds totaling $56350 were added to this PE.

FY05 Congressional adds with no R-2A:
($4027) Advanced Passive Millimeter Wave Imager, Project K73: The purpose of this one year Congressional add is to mature the Millimeter Wave Imager for obstacle avoidance, landing guidance and search and rescue scenarios. No additional funding is required to complete this project.

($11988) Buster Backpack UAV, Project K73: The purpose of this one year Congressional add is to demonstrate enhanced operation and flight characteristics of the Buster Backpack UAV with advanced sensor payloads. No additional funding is required to complete this project.

($1438) Camera Assisted Monitoring System (CAMS), Project K73: The purpose of this one year Congressional add is to mature robust suites of mobile & fixed security capabilities, processes, and procedures that support the missions of DoD and other Government agencies charged with homeland security. No additional funding is required to complete this project.

($1918) Cerberus Sensor Suite Program, Project K73: The purpose of this one year Congressional add is to mature a tower-mounted sensor suite for outward looking (beyond the fence) perimeter security and intrusion detection, employing multiple detection and assessment technologies for a variety of terrain applications. No additional funding is required to complete this project.

($2302) Cost Effective Targeting System (CETS), Project K73: The purpose of this one year Congressional add is to mature CETS for integration into the Stryker vehicle, and demonstrate the operational utility of CETS to provide fully autonomous target detection, tracking and cueing. No additional funding is required to complete this project.

($3165) IED Locating Low-Cost, Long Endurance UAVs, Project K73: The purpose of this one year Congressional add is to mature sensors and related payload capabilities to increase the ScanEagle Unmanned Aerial Vehicle's (UAV) ability to detect Improvised Explosive Devices (IED) placed alongside roads. No additional funding is required to complete this project.

($1343) Mobile Chemical Agent Detector (MCAD) for Tactical Unmanned Aerial Vehicle (TUAV), Project K73: The purpose of this one year Congressional add is to mature a compact airworthy standoff chemical agent detector for TUAVs. No additional funding is needed to complete this project.

($959) Multi-Color, Multi-Function Focal Plane Array for Targeting and Fire Control, Project K73: The purpose of this one year Congressional add is to mature a large format third generation Dual Color infrared focal plane array for target acquisition. No additional funding is required to complete this project.

($4794) Night Vision Advanced Technology (NAS project), Project K73: The purpose of this one year Congressional add is to mature the Massively Deployed Unattended Ground Sensors (MDUGS) technology into a smaller package. No additional funding is required to complete this project.

($5754) Night Vision Fusion Technology, Project K73: The purpose of this one year Congressional add is to demonstrate a digitally fused, image intensified complementary metal oxide semiconductor camera and an uncooled long wave infrared camera. No additional funding is required to complete this project.

($1438) Personal Miniature Thermal Vision System, Project K73: The purpose of this one year Congressional add is to demonstrate a Vanadium Oxide 320 x 240 miniature weapon sight as an enhancement for the Universal Soldier Sensor system. No additional funding is required to complete this project.

($8967) Sensor Technology for Force Protection, Project K73: The purpose of this one year Congressional add is to demonstrate multiple sensor modalities (Electro-Optical, Radar, Communications, etc.) integrated in a tactical package for force protection/counter terrorism capabilities. No additional funding is required to complete this project.

($959) Soldier Mobility and Rifle Targeting System (SMaRTS), Project K73: The purpose of this one year Congressional add is to mature solid-state detector arrays and electronics to provide the warfighter with improved SMaRTS sensor technology. No additional funding is required to complete this project.

($959) Virtual Event Perimeter (VEP) Digital Video Surveillance Program, Project K73: The purpose of this one year Congressional add is to demonstrate a family of scalable automated video surveillance solutions that provide event driven notifications and alerts for force augmentation. No additional funding is required to complete this project.

($2685) Warfighter/firefighter Position, Location, and Tracking Sensor, Project K73: The purpose of this one year Congressional add is to mature an afford

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603710A - NIGHT VISION ADVANCED TECHNOLOGY**	**590**

COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
590 OVERWATCH ACTD	1791	5542	1350	492	0	0	0	0

A. Mission Description and Budget Item Justification: This project matures and demonstrates technology that will enable real-time detection, location, and classification of small arms, mortars, and rocket propelled grenades (RPGs) in complex terrain. This Advanced Concept Technology Demonstration (ACTD) focuses on assessing the military utility of the technologies for locating enemy activity and real-time reporting of counter targeting information, and developing concepts of operation that address mobile force protection for unit of action forces involved in operations across the spectrum of conflict, from close combat to peacekeeping operations. The ACTD will mature and integrate a sensor/processor suite containing mid-wave infrared sensor, Electro-optical infrared imaging sensor, laser rangefinder/designator on a HMMWV with the appropriate C4I interfaces to disseminate information. Final product for the ACTD is a technology demonstrator that can be used to determine operational utility and deliver system performance specifications in support of the current force, Future Combat Systems, and Future Force requirements. Work in this ACTD is performed by the Army Research, Development and Engineering Command/Space and Missile Defense Command, and the Army Communications-Electronics Research, Development and Engineering Command/Night Vision and Electronic Sensors Directorate. Other agencies participating include the Office of the Secretary of Defense, U.S. Pacific Command, and Program Executive Office Intelligence, Electronic Warfare and Sensors. 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.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Overwatch ACTD. In FY04, matured threat signature database to support real time classification algorithms for small caliber weapons; matured infrared sensor data read-out performance and integrated sensor/processor/laser rangefinder/network interfaces for initial full scale functionality test on a HMMWV. In FY05, complete real time operational software, sensor shooter interfaces and communications hardware integration; demonstrate and evaluate the sensor/processor on a HMMWV; continue hardware/software maturation and conduct initial full-scale functionality tests, including capability to respond to threats from a full 360 degree region of concern; perform major system demonstration 1 using a HMMWV platform. In FY06, will build and integrate a second, more advanced, sensor system on Unmanned Ground Vehicle and conduct major system demonstration 2. In FY07, will provide system sustainment and technical support to users.	1791	5542	1350	492
Totals	1791	5542	1350	492

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603710A - NIGHT VISION ADVANCED TECHNOLOGY**	**K70**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
K70	NIGHT VISION ADV TECH	26905	19185	22521	23464	27511	27354	29290	29550

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 combat 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 Combat Systems (FCS), Future Force, and where feasible, exploits opportunities to enhance Current Force capabilities. This project will demonstrate ground-based Aided Target Detection/Recognition (AiTD/AiTR) and long range laser target identification utilizing short wave infrared components integrated into a surrogate target acquisition sensor suite including gimbaled-scanned, second generation Forward Looking Infrared (FLIR), day TV and laser range finder. The Networked Sensors for the Future Force (NSfFF) effort will demonstrate beyond-line-of-sight day/night targeting and situational awareness by demonstrating sensors and software that complement higher echelon surveillance for the Future Force. The NSfFF effort will also demonstrate next-generation, distributed, Unattended Ground Sensor systems (UGS) incorporating low-power infrared imaging and robust networking/communication technologies; a Cost Effective Targeting Sensor (CETS) for unmanned targeting, a new generation of low cost distributed unmanned networked sensor systems organic to the Reconnaissance, Surveillance and Target Acquisition (RSTA) team; and remote monitoring of an area of interest out to ~10km. Head Tracked Sensor Suite (HTSS) effort will demonstrate a day/night 360 degree X 90 degree dome of situational awareness coverage, enabling connectivity with the dismounted infantry during closed hatch operations. The Distributed Aperture System (DAS) will provide situational awareness imagery independently to the commander or multiple crew members for enhanced operations in day/night/adverse weather conditions. The Disposable Sensors effort will mature and demonstrate a new class of lightweight, very low-cost, disposable UGS systems that can be remotely delivered or hand emplaced and utilize various sensor technologies (acoustics, seismic, magnetic, infrared, imaging, and electronic/radio frequency) and algorithms to improve target detection, target identification, multi-target tracking, and information management. The Third Generation Infrared (3rd Gen IR) Technology effort will demonstrate the combat overmatch benefits of 3rd Gen IR technology; rapid wide area search, Multi-Spectral 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 and will support Horizontal Technology Integration (HTI) efforts to use standard components across multiple applications for cost savings. The Target Acquisition Sensor Suite (TASS) effort will demonstrate ground-based AiTR utilizing active short wave infrared components for long range identification. The HTI FLIR effort will mature the prototype 3rd Gen IR system components as a form/fit/function of the Future Combat Systems (FCS) Spiral Development, and long range line of sight combat vehicle sensor suites. The Soldier Mobility and Rifle Targeting System (SMaRTS) program will demonstrate technologies to improve soldier situational awareness.

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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Networked Sensors for the Future Force and NCR Portal. In FY04, fabricated and installed an advanced sensor package on a small UAV, completed the cost effective targeting system (CETS) design and demonstrated critical components technology performance in relevant environments; demonstrated a robust network of Unattended Ground Sensor (UGS) nodes, and began integration of sensors into the FCS Reconnaissance Surveillance and Target Acquisition (FCS RSTA) demonstrator platform; established secure, high bandwidth network connections between the Fort Belvoir NCR Portal and TRADOC Battle Lab Collaborative Simulation Environment (BLCSE) and Army Test and Evaluation Command (ATEC) Synthetic Environments Integrated Testbed (SEIT); supported a series of technical tests that linked the Fort Belvoir NCR Portal with Redstone Technical Test Center and White Sands Missile Range as part of a SEIT demonstration of a capability to support distributed, combined live and virtual testing of Future Combat Systems technologies. In FY05, complete integration of objective sensor systems, and integrate sensor management and acoustic/seismic planning tools into surrogate FCS RSTA demonstrator platform; develop and deliver UGS algorithms to demonstrate distributed cluster management capabilities to demonstrate reduced network loading and increased power efficiency; complete CETS sensor assembly integration, integrate CETS sensor and system control software/electronics into the UGV, complete system functional/acceptance testing, and deliver system; investigate dismounted reconnaissance team command and control configuration, conduct ATD final exit criteria demonstration with user participation at Fort Knox, and finalize specifications for system transition.	16286	9002	0	0
Head Tracked Sensor Suite (HTSS). In FY04, conducted critical design review to include optimization of the sensor layout within the Wescam XM15 system gimbal; conducted sensor gimbal thermal analysis; completed through-sight situational awareness overlay simulation, integration and evaluation by Armor Center subject matter experiments; demonstrated un-stabilized functionality of the coded laser pointer for dismounted operations. In FY05, integrate situational awareness network and high performance FLIR into the HTSS, integrate HTSS onto a combat vehicle and demonstrate HTSS image fusion, coded laser pointing and situational awareness network integration, and conduct limited user test and perform analysis of results to verify operability and utility.	4362	2605	0	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Distributed Aperture System (DAS). In FY04, conducted initial testing and soldier orientation of prototype DAS system with daylight color cameras. In FY05, integrate uncooled long wave infrared cameras with prototype DAS system, integrate prototype DAS on a troop carrying combat vehicle, conduct safety release and technical testing, and conduct limited user evaluations. In FY06, will integrate infrared and image intensification sensors into DAS for pixel level fusion; devise initial software modifications for automatic cueing of pop-up/moving personnel targets; conduct experiments to investigate potential to assist threat warning system with uncooled thermal DAS. In FY07, will integrate DAS in troop carrying combat vehicle and conduct final DAS user experimentation.	400	600	3000	3000
Disposable Sensors. In FY04, completed imaging data collection testbed units, communications network system investigation. In FY05, complete non-imaging data collection testbed units; utilize testbed units to support development of proof-of-principle sensors and measure/predict their performance parameters; develop proof-of-principle sensor hardware and display software and utilize them to conduct tests and demonstration of system; refine system concepts and system performance specifications. In FY06, will develop breadboard prototypes and conduct tests to finalize mix of sensor modalities for non-imaging sensor; investigate techniques and designs to extend sensor mission life; develop and test improvements to communications and networking sub-system; improve performance algorithms through integration of sensor components; investigate alternative sensor employment techniques. In FY07, will complete development and fabricate reduced size, weight, and power hand-emplaced sensors with improved performance algorithms, communications, and networking; conduct tests in simulated urban and open environments, and conduct system demonstration of soldier level use in urban terrain.	2503	2802	7150	8552

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
3rd Generation Infrared Technology. In FY04, conducted initial modification of Multi Function Staring Sensor Suite (MFS3) for an early simultaneous Dual Band focal plane array (FPA) 640x480 with single F# Dewar; conducted initial design of 3rd Gen Long Range Advanced Scout Surveillance System (LRAS3) test-bed to include enhanced signal processing techniques; conducted initial 3rd Gen system and component modeling; conducted initial design of Aviation Turret for 640 x 480 FPA and enhanced signal processing techniques; conducted initial development of a common air and ground Third Generation FPA integrated detector/cooler assembly (IDCA) requirement. In FY05, complete MFS3 mod; conduct 2-band MFS3 on the move field experimentation to determine military significance and man-in-the-loop considerations; complete LRAS3 mod for Dual Band Focal Plane manufacturing (DBFM); conduct initial modification of the Aviation Turret for DBFM and enhanced signal processing techniques; continue 3rd Gen modeling; continue development of long-range air and ground Third Generation FPA Integrated Detector/Cooler Assembly (IDCA) requirements. In FY06, will complete LRAS3 mod; insert Multi-Spectral AiTD/AiTR in LRAS3 test-bed for initial field testing and experimentation; complete Airborne Control Station fabrication; complete Aviation Turret mod and install in Blackhawk; continue 3rd Gen modeling; complete development of common air and ground IDCA specifications. In FY07, will demonstrate and field test upgraded Multi-Spectral AiTD/AiTR in LRAS3 in manual slew; demonstrate Rotary Wing long range ID; flight test single color AiTR in Rotary Wing application; start integration of Aviation Turret in Fixed Wing Aircraft (UAV Class IV surrogate).	851	1874	4644	980
Target Acquisition Sensor Suite (TASS) Technology Maturity Demonstrator. In FY04, completed system modeling and design, sub-system interface definition, forward looking infrared-aided target recognition (FLIR - AiTR) interface definition, sub-system and system integration and test, vehicle integration and conducted imagery collection at Yuma Proving Grounds for training/tuning of algorithms. In FY05, conduct imagery data collection at Fort Hunter Liggett and McCoy for training/tuning of algorithms and conduct non-real time evaluation of AiTR performance against sequestered imagery sets. In FY06, will demonstrate field performance of AiTR algorithms at three test sites; demonstrate long range laser target identification capability of high powered laser-gated short wave infrared; complete final report.	2503	2302	3742	0

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
HTI FLIR for FCS. In FY06, will complete sub-system and system level interface definition and system modeling for the insertion of large format, 3rd Gen detector/dewar assembly into the aviation turret long range sensor suites, and the prototype 3rd Gen Long Range Advanced Scout Sensor Suite (LRAS3) ground platform; complete the sub-system and system interface definition for the gimbal scanned 3rd Gen LRAS3 coupled with 2-color aided target detection (AiTD) processor. In FY07, will conduct initial design modification of the aviation turret and LRAS3 ground based long range and medium range sensor suites for the upgrade to large format 3rd Gen detector/dewar; perform initial integration of the 3rd Gen LRAS3 with the 2-color AiTD processor onto the gimbal system; perform initial design of the common electronics for the Air and Ground sensors.	0	0	3485	9932
Soldier Mobility and Rifle Targeting System (SMaRTS) Demonstration. In FY06, will initiate and complete system component definition, modeling, and design for a low cost all indirect view near-IR/uncooled-IR manportable sensor. In FY07, will begin sold state detector array and fusion processing component development, and electronic architecture definition, suitable for system integration into improved situational awareness capability.	0	0	500	1000
Totals	26905	19185	22521	23464

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603710A - NIGHT VISION ADVANCED TECHNOLOGY**	**K86**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
K86	NIGHT VISION, ABN SYS	7928	17597	21716	20885	11767	12309	16381	16500

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 Future Combat Systems (FCS) and Future Forces' light maneuver forces. The technology efforts focus on improved RSTA and night pilotage sensors, improvised explosive device (IED) detection, 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). The Hyperspectral Airborne Multi-Mission Exploitation and Reconnaissance (HAMMER) effort will conduct sensor evaluations and algorithm research to demonstrate day/night detection of mines and difficult target (e.g. camouflage, concealment and deception). The Networked Sensors for the Future Force effort will mature and demonstrate multi mission (RSTA, Countermine) day/night targeting sensors and software for small UAVs for the Future Force within a system of systems environment. Technologies to be addressed include mission planning tools and ultra-light payloads for small UAVs. The mission equipment package for the Class II UAV will mature and demonstrate small, lightweight, payloads (electro-optical/infrared, laser radar) to support target detection, identification, location, tracking and targeting of difficult targets for the Brigade Combat Team. The Third Generation Infrared Technology effort for aviation will improve survivability and lethality by providing identification at enemy's detection ranges and will support horizontal technology integration (HTI) efforts to use standard components across different applications for cost savings. The Distributed Aperture System (DAS) for aviation will provide pilotage and situational awareness imagery to multiple pilots/crewmembers independently for enhanced crew/aircraft operations in day/night/adverse weather conditions.

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 & Electronic Sensors Directorate (NVESD), Fort Belvoir, VA.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Hyperspectral Airborne Multi-Mission Exploitation and Reconnaissance (HAMMER) Program. In FY04, performed phenomenology analysis with long wave infrared (LWIR) data; matured countermine and camouflage, concealment and deception target exploitation algorithms. In FY05, continue development and evaluation of countermine and target exploitation algorithms and implement in real time code. In FY06, will integrate real-time processor with a LWIR hyperspectral sensor system and conduct technology demonstrations of countermine and target exploitation algorithms on an airborne platform.	950	1502	2735	0
Networked Sensors for the Future Force ATD. In FY04, completed UAV countermine payload and integrated UAV and ground based sensors, networked communications and sensor data management to demonstrate a network of distributed sensors. In FY05, conduct flight tests/demonstrations of UAV countermine payload and will demonstrate multiple UAVs as part of a networked system in an operational environment, conduct refinements based on test results, and demonstrate multiple UAVs in a final demonstration. In FY06, will conduct additional cost effective targeting system (CETS) field testing in varying environments and mature advanced digital electronic image processing technologies to improve performance.	2284	5639	1000	0
Mission Equipment Packages (MEP) for Class II Unmanned Aerial Vehicle (UAV). In FY04, completed trade studies, refined sensor concepts, and began system design for a reconnaissance, surveillance, and target acquisition (RSTA)/laser designation payload that has a payload weight less than 20 pounds for small UAVs. In FY05, complete trade studies and begin maturation of a RSTA/laser designation payload; conduct laboratory/field demonstrations of active imaging foliage penetration (FOPEN) target location technologies; and conduct studies to investigate non-imaging FOPEN techniques. In FY06, will complete RSTA/laser designation payload and integrate onto a manned testbed aircraft; demonstrate and evaluate non-imaging FOPEN approaches. In FY07, will conduct flight tests and final demonstration of RSTA/laser designation payload, begin integration onto surrogate Class II UAV and demonstrate recommended active imaging and non-imaging FOPEN system concepts.	3294	8129	10981	11757

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Third Generation Infrared Technology. In FY04, evaluated and quantified the applicability of advanced technologies based on visible, laser augmented short wave infrared (IR), mid wave (MW) IR and two-color Gen III thermal imaging for improved long range identification for rotary wing and UAV applications. In FY05, test 640x480 Gen III sensor and enhanced signal processing techniques on modified aviation turret. In FY06, will integrate 640x480 Gen III sensor into an aviation turret and install it with enhanced signal processing techniques into a testbed helicopter. In FY07, will flight test Gen III technology and analyze flight data to demonstrate feasibility of target detection and identification in two-colors; flight test a single color Aided Target Recognition (AiTR) system in a rotary wing aircraft to obtain baseline data prior to follow-on two-color AiTR flight testing and data analysis, to be conducted in the out-years.	1400	2327	7000	7838
Distributed Aperture System (DAS) for Aviation. In FY07, will evaluate potential concepts and conduct the preliminary design of an aviation DAS for pilotage based upon consolidated pilotage/situation awareness requirements for the UH-60, CH-47, AH-64, and the new Armed Reconnaissance Helicopter.	0	0	0	1290
Totals	7928	17597	21716	20885

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**

	COST (In Thousands)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	19942	17933	12606	13659	14898	16255	16439	16608
002	ENVIRONMENTAL COMPLIANCE TECHNOLOGY	1359	630	1310	1916	2014	2043	2061	2077
025	POLLUTION PREVENTION TECHNOLOGY	2266	2671	3212	3426	3513	3603	3675	3748
03E	ENVIRONMENTAL RESTORATION TECHNOLOGY	11500	10749	8084	8317	9371	10609	10703	10783
03F	ENVIRONMENTAL QUALITY TECH DEMONSTRATIONS (CA)	2384	3883	0	0	0	0	0	0
EM3	PROTON EXCHANGE MEMBRANE FUEL CELL DEMO	2433	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this program element is to mature and demonstrate technologies that will 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 will 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 will 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). Work in this program element is performed by the U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, and the U.S. Army Research, Development and Engineering Command, headquartered at Fort Belvoir, Virginia.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	14666	12906	13826
Current Budget (FY 2006/2007 PB)	17933	12606	13659
Total Adjustments	3267	-300	-167
Net of Program/Database Changes			
Congressional Program Reductions	-267		
Congressional Rescissions			
Congressional Increases	4050		
Reprogrammings			
SBIR/STTR Transfer	-516		
Adjustments to Budget Years		-300	-167

Change Summary Explanation:

Two FY05 Congressional adds totaling $4050 were added to this PE.

FY05 Congressional adds with no R-2A:
($1007) Commercialization of Technologies to Lower Defense Costs, Project 03F
($2877) Fort Ord Lead Based Paint and Wood Recycling Initiative, Project 03F

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**	**002**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
002	ENVIRONMENTAL COMPLIANCE TECHNOLOGY	1359	630	1310	1916	2014	2043	2061	2077

A. Mission Description and Budget Item Justification: This project will mature and demonstrate technologies transitioned from PE 0602720A (Environmental Quality Technology), Projects 048 and 896 that will assist Army installations in achieving environmental compliance. These technologies will 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 wastes to satisfy hazardous waste reduction goals, and to avoid future hazardous waste disposal costs and liabilities to the Army. Technology demonstrated will 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. Efforts under this project will 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. 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 U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
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. In FY04, matured and demonstrated zero emission control system for control of HAP emissions from chromium plating operations. In FY05, mature and demonstrate complete emission control system for demil furnaces. Reconfigurable and Joint Training Ranges - In FY06, will mature acoustic emission data acquisition techniques and models for various weapon systems. In FY07, will integrate noise tools into Army range design protocols.	1359	630	1310	1916
Totals	1359	630	1310	1916

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**	**025**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
025	POLLUTION PREVENTION TECHNOLOGY	2266	2671	3212	3426	3513	3603	3675	3748

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, and (3) demonstration of advanced technologies to eliminate or significantly reduce the environmental impacts that threaten the sustainment of rocket and missile propellant production and maintenance facilities, and training ranges. These propellant technologies are transitioned from PE 0602720A, Project 895, and will ensure that advanced energetic materials required for Future Combat System (FCS) high performance munitions are developed that meet weapons lethality and survivability stretch 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). Work in this project is performed by the Army Research Laboratory (ARL) located at Aberdeen, Maryland, the U.S. Army Natick Soldier Center (NSC) located at Natick, MA, the Armaments Research, Development and Engineering Center (ARDEC) located at Picatinny Arsenal, NJ, and the Aviation and Missile Research, Development and Engineering Center (AMRDEC) located at Huntsville, Alabama.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**	**025**

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Sustainable Painting Operations – In FY04, demonstrated hazardous air pollutant (HAP) free general and high performance munitions coating materials. In FY05, demonstrate HAP free solvents for depainting. In FY06, will reformulate HAP free solvents, cleaners and thinners used in coating operations and processes. In FY07, will reformulate HAP free sealants and adhesives used in weapon system maintenance, production and industrial processes. Solid Waste Diversion - In FY04, matured demolition debris reduction technologies that enable materials' reuse and recycling. In FY05, demonstrate advanced technologies for the reuse and recycling of solid waste resulting from barracks and motor pool modernization programs. In FY06, will demonstrate solid waste minimization technologies for use in deployed base camp operations. In FY07, will demonstrate advanced nanocomposite packaging technologies to reduce the amount of packaging debris generated during deployed operations. Ordnance Manufacture, Maintenance, Use, and Surveillance - In FY05, identify potential benign propellant alternatives that eliminate or significantly reduce the environmental impacts associated with the manufacture, maintenance, use and surveillance of rocket and missile propellants. In FY06, will down select and demonstrate most promising benign propellant alternative that eliminates or significantly reduces the environmental impacts associated with the manufacture, maintenance, use and surveillance of rocket and missile propellants. In FY07, will demonstrate alternatives to hydrazine fuels.	2266	2671	3212	3426
Totals	2266	2671	3212	3426

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603728A - Environmental Quality Technology Demonstrations**	**03E**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
03E	ENVIRONMENTAL RESTORATION TECHNOLOGY	11500	10749	8084	8317	9371	10609	10703	10783

A. Mission Description and Budget Item Justification: This project will mature and demonstrate technologies transitioned from PE 0602720A (Environmental Quality Technology), projects F25 and 835 that improve the Army's ability to achieve cost-effective environmental restoration of contaminated (UXO, military unique compounds, and energetics) sites at its installations, active and inactive ranges, its rework and production facilities, and the battlefield. Technologies demonstrated within this project focus on reducing the cost of management and remediation of Army sites contaminated by hazardous/toxic material. Efforts under this project will enable the Army to prevent pollution of the air, soil, and groundwater at installations, ranges, facilities, and battlefield operations, and to comply with the myriad of federal, state, and host country regulations dealing with contaminated soil and groundwater. This program includes demonstrations to establish technological feasibility and assessments of performance and productivity, 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 U.S. Army Engineer Research and Development Center, headquartered at Vicksburg, Mississippi, performs this work.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Unexploded Ordnance (UXO) – In FY04, demonstrated an integrated suite of UXO detection multi-sensing and processing modes optimized for site-specific environmental characteristics; fabricated an optimized multi-sensor and data fusion analysis UXO detection/discrimination system; transitioned UXO detection/discrimination sensors and multi-sensing processes to the Army Environmental Center for demonstration/validation. In FY05, evaluate new innovative analysis algorithms and models for next generation multi-axis/multi-sensor UXO detection systems. In FY06, will develop UXO discrimination models for wide-area transmitter sensor systems and for multi-axis sensor systems. In FY07, will develop a model for active range real-time UXO discrimination, and the Management Aid for UXO Detection Efforts (MAUDE) software application for active range remediation.`	936	750	1461	1963
Hazard/Risk Assessment Tools for Military Unique Compounds – In FY04, completed the Army Risk Assessment Modeling System (ARAMS) version 2.0 containing higher order assessment methods (i.e., Geographic Information System based spatially explicit wildlife exposure model and contaminant fate and transport models); demonstrated and validated a rigorous ARAMS that seamlessly links models of exposure/effects with toxicological data for multiple species. In FY05, complete ARAMS version 2.1 with tutorials and case studies of cost effectiveness capable of assessing contaminant transport through multiple media types such as different soil types and predicting contaminant exposure and toxicity levels in humans and other organisms of concern; evaluate current practices of the Intelligence Preparation of the Battlefield (IPB) process to include threats, vulnerabilities, and after-action cleanup operations of toxic industrial chemicals and toxic industrial materials. In FY06, will inventory current IPB practices and conduct gap analysis. In FY07, will complete inventory of current IPB practices.	5400	3445	1460	1790

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
In Situ Remediation Technologies for Contaminated Groundwater and Soils – In FY04, completed evaluation of in situ physical and biological cleanup processes (in place without pumping or excavation) of explosive materials in groundwater, developed aggressive chemical metal treatment alternatives for small arms training ranges and recycling metal contaminated extracts for soils treatment systems. In FY05, continue development of in situ reactive barriers and/or reactive barriers coupled with biodegradation for treating explosive materials in groundwater, will complete cost-effective ex-situ lead electro-kinetic extraction, physical separation, and stabilization remediation technologies for inorganics with applicable evaluation tools for a wide variety of contaminated soils. Will evaluate advanced in situ inorganics treatment methods at small arms training ranges. In FY06, will complete development of in situ physical and biological cleanup processes for explosives in groundwater, will develop in situ chemical and phyto (plant uptake) treatment methods to immobilize inorganics at small arms training ranges. In FY07, will finalize in situ physical and biological cleanup processes for explosives in groundwater with process guidance, specifications, and protocols, and will continue development of in situ chemical and phyto (plant uptake) treatment methods to immobilize inorganics on berms at small arms training ranges.	2747	2575	1703	1521
Characterization, Evaluation and Remediation of Distributed Source Contamination on Army Ranges – In FY04, investigated geostatistical methods to predict distribution patterns of distributed contaminants across range landscapes; began development of topical treatment methods for in situ treatment of explosives contaminants on active ranges. In FY05, develop predictive model for distributed source contamination impacts on inactive and live fire training ranges; evaluate base hydrolysis technologies for topical site restoration on distributed contamination sources. In FY06, will develop a real-time detection capability for high concentration source zones for explosives and propellants, will develop topical treatment methods for blow-in-place and other high concentration source zones. In FY07, will complete a real-time detection capability for high concentration source zones for explosives and propellants and continue development of geostatistical methods to predict the distribution pattern of distributed contaminants; will develop advanced in situ explosives treatment processes for distributed source explosives contamination on active ranges.	1802	2709	2317	1865

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Long Term Monitoring Applications - In FY04, began advanced development of on-site sensors and quantitative chemical analysis of military relevant contaminants for in situ, near real-time monitoring of environmental cleanup actions, and evaluated commercial-off-the-shelf technologies for monitoring and analyzing military unique compounds on site. In FY05, continue development of cost-effective, long term monitoring systems that will greatly reduce the frequency of manual sampling and off-site laboratory analysis, and complete development of standardized analytical methods for nitrocellulose and perchlorate. In FY06, will develop adaptations of commercially available direct-push wells for long term monitoring applications, and evaluate field portable sensors, sampling, and analysis methods. In FY07, will integrate advanced development of 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.	615	1270	1143	1178
Totals	11500	10749	8084	8317

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY
3 - Advanced technology development

PE NUMBER AND TITLE
0603734A - Military Engineering Advanced Technology

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		12863	25657	7301	7562	6796	7585	5674	6691
T08	COMBAT ENG SYSTEMS	3299	3703	7301	7562	6796	7585	5674	6691
T13	STATIONARY POWER & ENERGY TECH DEMONSTRATIONS (CA)	9564	15723	0	0	0	0	0	0
T15	MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)	0	6231	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: The objective of this program element 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 program element 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 Service (J-GES) technologies. BTRA will enable the warfighter to understand the impact of the terrain and weather effects during planning and execution of military operations. The J-GES prototype program will enable technology development 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, Mississippi, executes the project work.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	3865	5358	6006
Current Budget (FY 2006/2007 PB)	25657	7301	7562
Total Adjustments	21792	1943	1556
Net of Program/Database Changes			
Congressional Program Reductions	-372		
Congressional Rescissions			
Congressional Increases	22900		
Reprogrammings			
SBIR/STTR Transfer	-736		
Adjustments to Budget Years		1943	1556

Change Summary Explanation:
FY06 - Increase funding ($1943K) supports the Joint - Geospatial Enterprise Service (J-GES) to enable timely delivery of critical terrain and weather effects information and knowledge to C2 Services on FCS weapons platforms, soldier systems and UE and higher echelons.
FY07 - Increase funding ($1556K) supports the Joint - Geospatial Enterprise Service (J-GES) to enable timely delivery of critical terrain and weather effects information and knowledge to C2 Services on FCS weapons platforms, soldier systems and UE and higher echelons.

Ten FY05 Congressional adds totaling $22900 were added to this PE.

FY05 Congressional adds with no R-2A:
1 Megawatt Molten Carbonate Fuel Cell Demonstrator, Project T13 ($1439)
Advanced Mobile Microgrid, Project T13 ($2973)
Battlefield Production of Hydrogen for Fuel Cell Vehicles, Project T13 ($959)
Defense Applications for Thermo-Electric Power Generation Devices, Project T13 ($1918)
Defense Applications of Stationary Carbonate Fuel Cells, Project T13 ($1918)
Integration of Commercial GIS Capabilities into Army C4ISR (TEC), Project T15

($2877)
Mobile Transformers and Mobile Substations Demonstration Project, Project T15 ($959)
Ramgen/Fuel Cell Hybrid System, Project T13 ($4124)
Solid Oxide Fuel Cell (SOFC) Development for Defense Applications, Project T13 ($3356)
US Army Advanced Structures and Composites in Construction Research, Project T15 ($2397)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603734A - Military Engineering Advanced Technology**	**T08**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
T08	COMBAT ENG SYSTEMS	3299	3703	7301	7562	6796	7585	5674	6691

A. Mission Description and Budget Item Justification: The objective of this 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 will support the expedient upgrading of existing airfields and rapid construction of new contingency airfields. Battlespace Terrain Reasoning and Awareness (BTRA) technologies will enable the warfighter to understand the impact of the terrain and weather effects during planning and execution of military operations. The Joint-Geospatial Enterprise Service (J-GES) prototype program will enable technology development 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, Mississippi, executes the project work.

Accomplishments/Planned Program	FY 2004	FY 2005	FY 2006	FY 2007
Joint Rapid Airfield Construction – In FY04, demonstrated site selection, enhanced construction, and rapid stabilization technologies for C-130 contingency airfield operations. In FY05, integrate performance models into the site selection process and select lightweight matting systems and all-weather soil stabilizers. In FY06, will select maintenance and repair techniques for contingency airfields. In FY07, will demonstrate all JRAC technologies for C-17 contingency airfield operations.	3299	3703	3895	1962
Joint-Geospatial Enterprise Service - In FY06, will utilize a network-centric architecture to demonstrate basic geospatial information services from multiple locations. In FY07, will expand J-GES capabilities and demonstrate and test these geospatial services across a broader, more complex network to Army programs and other Services/DOD activities; will test and evaluate geospatial data/information flow across multiple echelons to support battle command planning and mission rehearsal.	0	0	2020	2748

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
Battlespace Terrain Reasoning and Awareness Demonstrations - In FY06, will establish four experimental BTRA platforms at Ft. Huachuca, Ft. Leavenworth, Ft. Benning, and Joint Forces Command, and conduct initial demonstration of tactical bandwidth compatible situation and threat assessment tools within battlefield functional area processes and battlefield operating systems architectures. In FY07, will demonstrate, test and evaluate spatial analysis and predictive analysis tools in warfighter experiments within battle command and intelligence, surveillance and reconnaissance user tools.	0	0	1386	2852
Totals	3299	3703	7301	7562

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE
3 - Advanced technology development	**0603772A - Advanced Tactical Computer Science and Sensor Tech**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		24458	46313	42475	49279	35181	29688	29966	30212
101	TACTICAL AUTOMATION	14923	14401	13038	17950	20124	21226	18759	18895
1AA	TACTICAL COMPUTER SCIENCE DEMONSTRATIONS (CA)	2724	1917	0	0	0	0	0	0
1AB	SENSOR DEMONSTRATIONS (CA)	1946	13516	0	0	0	0	0	0
243	SENSORS & SIGNALS PROC	4865	16479	29437	31329	15057	8462	11207	11317

A. Mission Description and Budget Item Justification: This Program Element (PE) supports information dominance for the Army's Future Combat Systems (FCS), 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 more effectively collect, transfer and display digital information around the battlefield. It provides architectures and technologies to enable Command and Control (C2) during rapid, mobile, dispersed operations. It demonstrates technologies necessary for integrated battlefield situational awareness (SA), force synchronization, split-based, and On-the-Move (OTM) C2 operations. Project 243, Sensors & Signal Processing, matures signal processing and fusion technologies for Army sensors; matures and demonstrates ground based radar systems to track and identify enemy forces and personnel; matures and demonstrates multi-sensor control and correlation for improving reconnaissance, surveillance 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), and PE 0603008A (Electronic Warfare Advanced 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.

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2005)	31951	52647	53762
Current Budget (FY 2006/2007 PB)	46313	42475	49279
Total Adjustments	14362	-10172	-4483
Net of Program/Database Changes			
Congressional Program Reductions	-648		
Congressional Rescissions	-38		
Congressional Increases	16100		
Reprogrammings			
SBIR/STTR Transfer	-1052		
Adjustments to Budget Years		-10172	-4483

Change Summary Explanation:
FY06 - Funds realigned ($10172K) to higher priority requirements.

Ten FY05 Congressional adds totaling $16100 were added to this PE.

FY05 Congressional adds with no R-2A:
($959) ASAS Light RDTE Development, Project 1AB: The purpose of this one year Congressional add is to develop an interface for the Unmanned Ground Sensor (UGS) sensor hub and provide the appropriate visualization and query tools. No additional funding is required to complete this project.

($1630) Blast and Damage Assessment Risk Analysis and Mitigation Application (BADARAMA), Project 1AB: The purpose of this one year Congressional add is to integrate Force Protection/Blast Visualization Software. No additional funding is required to complete this project.

($958) Digital Army Radar Technology, Project 1AB: The purpose of this one year Congressional add is to mature, and demonstrate technologies for a next generation, digital array that can perform multi-mission functions such as air defense, counter fire target acquisition, precision target identification, active fire and air traffic control. No additional funding is required to complete this project.

($959) Distributed Scalable C2 Communications System, Project 1AA: The purpose of this one year Congressional Add is to produce a collaboration system to permit the commander and field soldier to markup 2D and 3D virtual battlefields in order to query, clarify and refine directives. No additional funding is required to complete this project.

($1247) Dominant Military Operations on Urbanized Terrain, Project 1AB: The purpose of this one-year Congressional add is to develop a long range, stand off, three dimensional imaging radar for covert interior imaging of fortified bunkers and urban structures. No additional funding is required to complete this project.

($2397) LCMR-Capabilities Enhancement, Project 1AB: The purpose of this one-year Congressional add is to enhance the Lightweight Counter Mortar Radar in response to feedback from OEF/OIF. Modifications include improved ruggedness, increased range, improved accuracy and reduced false alarms, improved user interface and automatic digital messaging. No additional funding is required to complete this project.

($959) MVMNT Program for Simulation Based Operations, Project 1AA: The purpose of this one year Congressional Add is to develop software tools for the virtual fabrication and configuration management of C4ISR systems embedded in/on vehicular and/or soldier platforms. No additional funding is required to complete this project.

($2110) PING Wideband RF Target ID Systems, Project 1AB: The purpose of this one-year Congressional add is to enhance the current PING system to: (1) improve the likelihood of correctly identifying concealed weapons behind visible obstructions; (2) increase the range of detection and provide faster algorithm processing; and (3) operate while on the move. No additional funding is required to complete this project.

($3260) Radar Tags, 1AB: The purpose of this one-year Congressional add is to enhance Blue Force Tracking and Combat ID through acceleration of radar tags electronic unit development, including field testing/demonstrations using existing radars. No additional funding is required to complete this project.

($959) Weather Intelligence Sensor System, Project 1AB: The purpose of this one-year Congressional add is to develop a lightweight passive weather suite to collect local weather information critical to radio/satellite communications transmissions and ballistic accuracy. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603772A - Advanced Tactical Computer Science and Sensor Tech**	**101**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
101	TACTICAL AUTOMATION	14923	14401	13038	17950	20124	21226	18759	18895

A. Mission Description and Budget Item Justification: This project provides improved command and control architectures and technologies for Future Force information dominance. For the Army Future Force, the key change in battle command will be in the use of automated information technologies embedded throughout its units that enable it to use information as an element of combat power. This project supplies the tools to provide commanders at all echelons better and more timely information and allow them to command from anywhere on the battlefield, freed from their command posts and while on-the-move. 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: digital transfer and display of horizontal battlefield situational awareness (SA) and 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. Networked Sensors for the Future Force matures and demonstrates C2 technologies to enable the commanders to effectively manage and utilize the emerging host of unmanned sensors and platforms carrying them, while at the same time increasing organizational agility on the future battlefield. Network Enabled Battle Command (NEBC) matures and demonstrates advanced C2 software services for the Unit of Employment (UE) and software services for seamless Unit of Action (UA) /UE interoperability. Command and Control of Robotic Entities (C2ORE) Matures and demonstrates application domain software services for use with unmanned air and ground robotic systems for the Future Combat Systems (FCS) Battle Command System (BCS). Joint developer/warfighter demonstrations will be conducted in coordination with the UA, dismounted, battle command and combat service support battle labs.

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 2004	FY 2005	FY 2006	FY 2007
- Distributed Command and Control (C2) On-the-Move: In FY04, demonstrated capability to monitor the execution of 100 events; delivered decision support software to serve as the common component integrating multiple battlelabs in a series of collaborative experiments; demonstrated adaptive command and control applications working within a quality-of-service communications network. In FY05, mature a distributed collaboration software environment for use in complex and urban terrain, and mature lightweight geospatial service-based mapping tools, coupled with mobile software agents for use in a mobile environment. In FY06, will prototype a set of service-based decision support and C2 modeling and simulation tools for dismounted Future Force commanders to collaboratively plan coalition activities in highly mobile operations. In FY07, will mature software tools for transition and use on Land Warrior, Future Force Warrior and Commander's Digital Assistant programs.	11543	2478	2380	1425
- Networked Sensors for the Future Force: In FY04, leveraged, customized, matured and integrated C2 tools for sensor mission planning; conducted experiments to demonstrate C2 tools for networked sensors; participated in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) demonstrations with unmanned networked sensors and platforms. In FY05, enhance C2 tools and mature decision aids to support semi-automatic sensor mission planning and management; conduct experimentations to demonstrate C2 for networked sensors; participate in C4ISR demonstrations with multiple unmanned networked sensors and platforms.	3380	3000	0	0
- Network Enabled Battle Command (NEBC): In FY05, mature techniques for measuring situation awareness and decision quality and integrate into demonstration plans; mature and demonstrate mission plan representation tools. In FY06, will mature and demonstrate technologies to support the interfacing and information exchange management between UA/UE C2 software applications and Army, Joint, Coalition and National information systems. In FY07, will demonstrate and transition to Joint Command and Control (JC2) System execution decision support services for Current Force/UE; will transition information exchange/interface technologies to FCS for integration into System of Systems Common Operating Environment (SOSCOE) software.	0	6300	7000	7400

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Command & Control of Robotic Entities (C2ORE): In FY05, establish baseline M&S environment; define interfaces to support system of systems integration; complete identification of candidate software services; and define prototype software services. In FY06, will mature software service candidates per M&S based assessment; and identify and mature "best of breed" unmanned air-ground systems and technologies. In FY07, will create prototype software services and demonstrate in M&S environment; conduct experiment to characterize communications baseline and perform system of systems evaluation of integrated prototype software services using selected tactical application scenarios; will continue M&S refinement of software services and integrate selected software services with FCS BCS Build 4.	0	2623	3658	9125
Totals	14923	14401	13038	17950

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2005

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
3 - Advanced technology development	**0603772A - Advanced Tactical Computer Science and Sensor Tech**	**243**

COST (In Thousands)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
243	SENSORS & SIGNALS PROC	4865	16479	29437	31329	15057	8462	11207	11317

A. Mission Description and Budget Item Justification: This project provides improved ground based radar, sensor fusion and correlation technologies for Future Force information dominance. The Multi-Mission Radar (MMR) program will mature a Multi-mission HMMWV mounted radar technology to support air defense, counter-battery, and air traffic control missions within a single system to enhance Future Combat Systems (FCS) 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. The Eye in the Sky (EIS) program will demonstrate cross-sensor control and data correlation (Fusion) of a multi-function, integrated sensor payload. Sensor suite candidates may include moving-target-indicator (MTI)/synthetic aperture radar (SAR), Night Vision and Electronic Sensors Directorate (NVESD)'s electro-optical/infrared (EO/IR) and signals intelligence technologies. This sensor suite will demonstrate wide area reconnaissance, surveillance, and targeting capability in adverse weather on manned and tactical unmanned aerial vehicles (UAVs), such as the A-160. Synergistic operation of sensors with on-board sensor management and the correlation of data for an integrated operational picture will be matured with significant leveraging of signal processing achievements from industry, Defense Advanced Research Projects Agency (DARPA) and other services. The Suite of Sense Through the Wall Systems will mature techniques for detection of personnel and objects through multiple wall types.

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 2004	FY 2005	FY 2006	FY 2007
- Multi-Mission Radar (MMR): In FY04, matured radar antenna array; matured software to perform target classification, mission sorting, and target queuing management. In FY05, mature and demonstrate radar hardware and software; conduct systems engineering test to verify hardware and software; conduct initial field tests against targets of opportunity. In FY06 will perform radar system test against dedicated targets to validate performance; will conduct demonstration of system capabilities to user community, and deliver prototype MMR system and prime item development specification suitable for moving into system development and demonstration phase in support of Future Force MMR development.	4865	6579	5100	0
- Eye-in-the-Sky: In FY05, conduct operational concept study for integration of multi-sensor payload for Class IV UAV; begin mission management module design and maturation for cross-sensor control and data correlation; establish a simulation effort to identify means of autonomous sensor management to capitalize on sensor synergies and identify commercial off-the-shelf/Government off-the-shelf sensors for the multi-sensor payload. In FY06, will complete system hardware design and level 1 fusion algorithms/software for automated data correlation and target tracking; will begin to integrate sensors and payload onto Blackhawk aircraft and conduct limited flight-testing in the Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) On-the-Move (OTM) Demonstration at Fort Dix. In FY07, will mature and demonstrate target patterns recognition software for automatic cross-cueing of sensors; will develop sensor performance analysis tools and aircraft platform sensor management tool; will complete integration of sensors onto Blackhawk and conduct flight-testing in the C4ISR OTM Demonstration.	0	6024	18481	24472

Accomplishments/Planned Program (continued)	FY 2004	FY 2005	FY 2006	FY 2007
- Suite of Sense Through the Wall (STTW) Systems for the Future Force: In FY05, integrate prototype STTW systems with emerging FCS UA and Future Force Warrior (FFW) network communications architecture to demonstrate transmission of STTW data on a real time basis; evaluate data transmission, dissemination and software tools; provide STTW performance model for incorporation into Battle Lab and FFW operational modeling and simulation; evaluate technology advancements for use in personnel detection, concealed explosive detection and concealed weapons detection. In FY06, will conduct lab and user testing of STTW prototypes; utilize experiments to characterize urban and complex terrain phenomenology; mature techniques for the detection of stationary personnel through light construction materials. FY07, will mature and demonstrate integrated personnel detection/Concealed Weapon Detection (CWD)/Concealed Explosive Detection (CED) systems with greater standoff capability and increase 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 types and participate in C4ISR OTM Demonstration as well as FFW ATD with hand held STTW prototype.	0	3876	5856	6857
Totals	4865	16479	29437	31329